The American Journal of Surgery

NEW SERIES VOL. VII DECEMBER, 1929 No. 6

HYDRONEPHROSIS*

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DEALING with such an important structure as the kidney the aim of our therapy should be to save this organ. Although we are not able to do so in certain diseases of the kidney, yet we have in various other conditions a possibility for conservative surgical intervention. Here is evident the progress which has been made in our specialty in the past twenty years. Conservative surgical treatment of kidney disorders is based upon improvement of diagnosis, recognition of the pathogenesis, and investigation of their pathological physiology. Many problems in kidney surgery have yet to be solved and many other questions are still open. It seems to me that with the growing knowledge we will establish new and as yet unknown clinical entities which will provide research workers with problems to be solved for a long period of time.

The advancement made in renal surgery as just stated is shown best in the renal disorder commonly called hydronephrosis.

An effective therapy is a therapy which eliminates the cause of the malady. If the pathological process is not advanced too far, if we are not dealing with a permanent structural change, we have a possibility of a complete cure, or at least a chance of a partial saving of the kidney. An efficient therapy, therefore, depends upon the recognition of the pathology of the disease, which means a thorough diagnostic investigation and a definite conception of the etiology, which renders it feasible to establish a working hypothesis, a working theory, as a foundation for a practical and efficient plan of treatment. These two principles are very important.

In hydronephrosis both these principal conditions are very favorable, as we are able to show all the morphological changes in detail by means of pyelography, which enables us to discover its pathogenesis. The pathological physiology is not yet fully known, but our present knowledge is sufficient to outline the necessary therapeutic working hypothesis.

For the last twenty years I have taught and emphasized again and again that the technical term hydronephrosis is wrong, because this expression covers various different pathological conditions, which have in common with each other only the same morphological picture.

The pathological changes in the kidney are fundamentally exactly alike, yet the pathological conditions creating them are many-sided and unlike. This morphological similarity does not concern the nature of the disease or the pathological process. It is the consequence of numerous and different pathological lesions upon the kidney.

The true nature of hydronephrosis is urinary obstruction, or urinary clogging resulting from a distinct anatomical alteration or from a neurogenetic disorder of the urinary tract.

Instead of using the word hydronephrosis it would be better to call this

*Read at the meeting of the American Urological Association (New York Branch), June 5, 1929.

condition *Harnverstopfung*, which means urinary constipation, constipation used literally in the same sense as it is applied to the very common morbid inactivity of the bowels. American urologists call it obstructive uropathy, which does not mean exactly the same, but comes quite close to my conception of urinary constipation.

The pathological changes in the kidney which arise from the urinary constipation can be designated morphologically as back-flow kidney. This term includes all the different forms of pyelectasis.

The introduction of the term urinary obstruction, based on a physiopathological conception of hydronephrosis, lays stress upon the pathogenesis of the disorder, giving us a clear route for our conservative therapy.

In the first place we have to deal with the causes of the obstruction. We see that the hydronephrosis is not a disease of the kidney but a disorder of the entire genito-urinary system which should best be termed in an appropriate manner, according to the point at which the obstruction occurs and according to its character. It can be located in any part of the urinary tract from the ureteral pelvis junction down to the external ureteral orifice. The anatomical location gives the basis for the topographical classification of the disorder.

The nature of the obstruction can be mechanical or dynamic. It is mechanical in all cases of strictures, kinks or obstructions, dynamic in all disturbances of the innervation. This is evident in the atony, which might be primarily of nervous origin, through disease of the nerve supply in any part of its course, or primarily of muscular origin as I have proved in toxic paralysis of the ureteral musculature, as it is frequently seen for example in cases of infections of the colon. The determination of the nature and character of the obstruction makes possible a physiopathological classification of the different forms of urinary constipation.

By a topographical grouping we obtain a classification of all the different forms of urinary constipation and back-flow kidney comprising all the anatomical, pathological and physiopathological details. Thus we gain the aforementioned constructive conception and the useful therapeutic working hypothesis.

Dilatation of the urinary tract is a result of pressure, a simple physical principle, and resistance which is offered by the musculature anywhere in the system. It consists of two elements: the elasticity and thickness of the wall, which is a physical factor, and the effect of the innervation upon the musculature of the wall, which is a biological factor.

Relaxation of the musculature produces a dilatation which may be temporary or permanent, according to the duration and the degree of the relaxation. A permanent relaxation through a faulty innervation leads to the so-called atony which in partial paralysis also results in a dilatation of the parts which are located above without any visible anatomical stricture. There also exist paralytic and atactic forms of disturbances of innervation.

Increase of the pressure means additional work of the musculature. Finally the physiological limit of the elasticity is surpassed and the wall is overdistended. In this stage the contractility of the musculature is impaired and a complete evacuation of the hollow system is not possible. The development of this stage, the duration, the intensity of the compensatory hypertrophy of the musculature are different in individual cases and depend upon constitutional elements.

Without knowledge of these facts the pathogenesis of a number of urinary constipations would not be clear.

From the standpoint of treatment we are interested in the question of how far this disturbance undergoes a restitution or what influence an impairment or change of the dynamic action the urinary tract has upon the kidney.

An example of transitory urinary constipation is shown in the impacted ureteral

calculus in which even large dilatations are reduced almost completely and the normal function of the kidney is reestablished. The hypertrophy of the musculature is apt to return to normal as we know from the muscular physiology. The same is also true of the elasticity of the wall. Not infrequently we notice in operating on such cases that even markedly dilated and thickened ureters show very great and pronounced peristalsis, a sign of an excellent dynamic compensation. This is most often found in prolonged duration of impacted stones.

In acute cases of impaction we observe a predominance of the dilatation over the hypertrophy and we see a transparent thinned wall and a complete atony. Even then the peristalsis sets in right after the elimination of the obstruction. Where an infection causes an inflammatory process of the wall, either in the form of an acute edema or a chronic infiltration, we have a complete loss of the musculatory function. Our clinical experience teaches us that even in these conditions the normal function is later resumed. The observation of this phenomenon and our experience allows us to be optimistic in the judgment of the outcome of the urinary obstructions when the cause has been eliminated. This is the basis of our idea of the conservative treatment of urinary constipation.

For all renal forms of urinary constipation the anatomy of the pelvis is important. If the pelvis is intrarenal the pressure immediately affects the kidney parenchyma. If it is extrarenal the pressure is borne by the pelvis itself; the pelvis, acting as a reservoir, protects the parenchyma for along time. When the limit of this compensation is reached, the parenchyma of the kidney begins to suffer. We find in these cases, even with considerable distention of the pelvis, a relatively good function of the kidney. In such cases the delay of the appearance of the dye does not indicate impairment of the function, because the secreted dye mixes with the residual urine in the dilated pelvis before it appears in the bladder. While even marked cases of extrarenal pelvic dilatation have a favorable prospect under conservative treatment, the prognosis in the intrarenal pelvis is unfavorable, the more so as it is usually very difficult to entirely remove the cause of the distention.

Urinary constipation is a disease which may exist for a long time without any complaint. In the congenital cases we observe that symptoms usually do not occur before the second or third decade, when the disease is so far advanced that there is no possibility of conservative surgical intervention. Very often our attention is called to the condition by the enormous size of the sac. In other cases the patient exhibits attacks of pain, where retention interchanges with free urinary outflow. This intermittent course is characteristic. The variations in the clinical picture indicate differences in the anatomical structure. In the first group we are dealing with intracanalicular obstruction, and in the second group the cause is extramural usually from accessory vessels.

Therapy becomes imperative as soon as complaints from the patient urge us to intervene; the treatment should be adapted to the findings in the urinary tract.

A cure signifies the disappearance of complaints and the patient remaining symptomless. We cannot expect a *restitutio ad integrum* in the treatment of this disease. However, we may expect that the condition will not become progressively worse, and will possibly be improved.

There are still urologists who, as a rule, perform nephrectomy in all cases of urinary constipation. They claim that all conservative surgical treatment is of no avail and that the kidney has to be removed later on. This point of view is based upon wrong premises. Surgeons having large clinical experience with urinary diseases know how often they occur bilaterally. In nephrolithiasis, for this reason, we exercise extreme conservatism. Only in exceptional cases we perform a nephrectomy. In many cases constipation is found

to be bilateral, as we occasionally discover in a complete urological examination. Frequently we are able to recognize slight beginning changes in the quite healthy looking other side. This fact should be a warning to all who advise radical surgery. It is of no significance if the anatomical result of the operation is unsatisfactory. The aim of the treatment is not the restitution of a normal kidney pelvis, but the relief of the symptoms and the prevention of further damage to the renal parenchyma. In spite of occasional failures our endeavor should be the further development of conservative methods. For this purpose an exact diagnosis will help, allowing us to recognize any pathology early enough.

I should like to call attention to two early symptoms, first the one called *Stauunsgschmerz*, filling pain. This consists of a painful sensation which occurs when the kidney pelvis is filled, and which corresponds in character with the spontaneous pain of which the patient complains. This symptom is frequently already present in cases in which neither an increase of the pelvic capacity, nor the pyelography exhibits a urinary constipation. The second symptom is roentgenographic. I have called it the ventilphenomenon. The pyelography shows that after filling the renal pelvis the ureter remains empty. Also in more deeply located obstructions the urinary tract below remains unfilled. Further information is given by pyeloscopy and during the cystoscopic observation of the dynamic action of the ureter. The answer to these investigations is often a very early diagnosis.

In urinary constipation through abnormalities of the urinary tract the duration of the pathology is determinable. Frequently the back-flow kidney is developed in intrauterine life to such an extent that it is impossible to save it. From the first years of life the pathological process advances more and more. Very infrequently do we have the opportunity of applying conservative methods in those cases where clinical symptoms occur in the first decade of life. Although I have observed quite a number of cases in children, in only one case could I proceed with the conservative method. This was in a boy eight years of age. In cases of ureteral obstruction in young children, however, we have often the possibility of applying conservative surgery. In the second and third decade of life the congenital back-flow kidney has to be removed in most instances. An exception is the obstruction of the ureter through an accessory vessel, which lasts only a short period of time with long intervals between. Besides this, the effect of the crossing of the ureter by the vessels manifests itself very late and under unusual circumstances. At times, *even in the fourth decade of life* in this particular instance conservative surgery is possible.

The general opinion prevails that in infections conservative methods cannot be applied. Even acute purulent infection of the parenchyma is no contraindication for plastic surgery if there is no other alternative. I was able to completely cure a patient with a bilateral urinary constipation, with a carbuncle of the kidney on one side, by performing a uretero-pyeloneostomy. The temporary outflow of the urine from a small nephrotomy combats the infection, protects the anastomosis and helps the healing in such conditions.

A temporary fistula of the kidney in all plastic operations upon the kidney pelvis is, I believe, the reason for my good operative results. Because of its influence upon the healing process in a plastic operation of the urinary tract, inflammatory infiltration of the wall is most unfavorable. Therefore special caution is to be recommended in chronic purulent cases of pyelitis and ureteritis. At any rate, in infected back-flow kidneys nephrectomy is indicated only after thorough investigation of the anatomical findings.

One should attempt a good exposure of the operative field in order to exhibit topographically the kidney in situ. For this

reason I almost always resect the twelfth rib and sometimes the eleventh also. One must first find and expose the cause of obstruction, before the kidney is luxated, in order to be able to form a practical plan of operation.

Which forms of urinary constipation are most suitable for conservative surgery? Among the lower located obstructions, we have to mention in the first place the ureteral orifice and the intramural part of the ureter. Also these strictures are bilateral. I have worked out for these cases a simple operation which gives good anatomical and functional results. The other strictures can also be relieved if they are not complicated by a pyonephrosis. I split the stricture and leave an indwelling catheter, (10–12 chariere) in the ureter. This catheter is brought out through a small nephrostomy, and removed after twelve to fourteen days. By this time the ureteral wound has been filled out with the reproduction of mucus and muscle tissue. Kinks and fixed loops must be freed and accessory vessels dissected. One might state that the majority of the cases of distal obstruction can be relieved by conservative methods without removal of the kidney. In proximal renal obstruction the circumstances are less favorable. On account of total destruction of the kidney, nephrectomy has to be done in many cases. For the conservative treatment, we have a great number of plastic operations.

I wish to recommend my method of uretero-pyelo- neostomy which I have used for the past twenty years and which has proved very satisfactory to me. In spastic conditions of the ureteropelvic junction I advise an operation similar to the pyloroplasty of Heineke-Mikulicz. In strictures at the same point surgical dilatation with bougies is successful.

It will be of interest to hear of the results of my fundamental principles applied in clinical practice. For this purpose, I have collected all the cases treated in two years in my department, totalling 80 cases operated on for renal obstruction. In 41 per cent I had to remove the kidney as the destruction was complete. For the conservative treatment 47 cases, or 59 per cent, were left. In 23 cases no mechanical obstruction could be found. In 27 per cent of my material the cause of the obstruction was of neurogenic origin. In 12 of these cases, that is more than half, nephrectomy had to be done. Ten times Fenger's operation was performed; once this operation was combined with pyeloplication.

Congenital abnormalities were found in 20 cases, i.e. 25 per cent: 3 cases of faulty insertion, 2 cases of hypoplastic kidney and 15 cases of accessory vessels. Among these cases nephrectomy was performed 10 times, i.e. in 50 per cent of the cases. In 1 case reimplantation of the ureter, and in 9 dissection of an accessory vessel were performed. In 37 cases we dealt with strictures of the ureteropelvic junction. In 11 cases nephrectomy was done, (about 30 per cent). In 9 cases I did a uretero-pyelo-neostomy, in 11 cases the plastic operation of Fenger, in 2 reimplantation, in 4 surgical dilatation of the ureter. Among the 47 mentioned cases of conservative surgery we had to perform a secondary nephrectomy 3 times i.e. in about 7 per cent of the cases. We had no loss of life in any of these cases.

CONCLUSIONS

According to my conception of conservative surgery and my experience in treating urinary constipation I make the following conclusions:

1. In the treatment of back-flow kidney, a conservative method may be applied.
2. Its purpose is the elimination of the symptoms, and the maintenance or improvement, of the remaining kidney function.
3. The conservative procedure is indicated in all cases with bilateral constipation or where it is proved that the other kidney is also damaged.
4. Infection is no contraindication. A

temporary kidney fistula assists essentially in the success of the operation.

5. The radical operation removes, the palliative procedure disconnects, the pathogenetic lesion.

6. The kidney must be sufficiently exposed to give a clear picture in situ.

7. This necessitates removal of the twelfth rib and occasionally also the eleventh.

DISCUSSION

Dr. Benjamin S. Barringer: In his very extraordinary paper I am sure that Professor von Lichtenberg has given us all a new conception of the condition commonly called hydronephrosis. The ideas he has given us are new; I am not quite used to them, and I do not precisely perceive their import in all cases. I think the term "urinary constipation" is an extraordinarily nice phrase, and probably fits very well; but it requires thought to determine just how well it fits the case.

The description he has given us of the extrarenal pelvis exerting, as I understand it, pressure on the pelvis itself, and the intrarenal pelvis exerting pressure on the kidney parenchyma, is also a new idea. I had thought that any form of hydronephrosis exerted pressure on the parenchyma, and caused some obstruction of the kidney. I think we often omit a consideration of the old Kelly symptom of filling pain and reduplicating pain in pyelography. We depend on the pyelographic picture, and forget to ask the patient, in filling the kidney pelvis, if the pain which he has been complaining of is reproduced. This is an important point, and one which should not be overlooked; and it is worth while to have our attention recalled to it.

There are apparently various reasons for conservatism in the surgery of hydronephrosis and hydropyonephrosis. I think these are chiefly two, however. First, our methods of examination are singularly inadequate when it comes to a determination of precisely what a kidney is doing. I have several times duplicated my examinations and found myself entirely at fault as to a kidney's real functional capacity. In other words, a kidney which I thought had little or no functional capacity was only affected with urinary constipation, and really had good function, entirely at variance with my original opinion. And secondly, we do not know how far a kidney is capable of returning to normal. That is apparently an unknown problem. A kidney which is infected (if we are clever enough in our operation, manipulation and antisepsis to permit it) can return to normal even if very much diseased. There is no standard by which we can judge, prior to operation, what a kidney can do.

It is extraordinary what differences of opinion there are as to methods of operation and the indication for surgery in hydronephrosis. I believe that I think a large infected hydronephrosis with no function should be nephrectomized; although even then I do not feel any of us knows precisely what kidney should be nephrectomized. It is an individual problem, in its final analysis.

I am frank to confess that to me it is rather difficult to do a resection of the eleventh or twelfth rib, especially the eleventh, as in the conservative operation. I have therefore felt that there were certain cases on which we had to do a nephrectomy. There are certain other cases which are considered subjects for conservative operation, notably cases of small, somewhat limited hydronephrosis caused by some form of stricture, such as aberrant vessels, twisting of the ureter in the upper portion, etc. I think most people have thought that hydronephrosis caused by some condition in the lower ureter, such as stricture, should be first controlled by ureteral dilatation, while the upper ureter conditions rarely respond to ureteral dilatation.

The variety of concepts as to a proper procedure among different members of the profession is most extraordinary. Sometime ago I had occasion to refer to Dr. Frank Hinman on the subject of hydronephrosis, and I find that he believes an operation for a small hydronephrosis on one side to be impossible, while it is most feasible on both sides, because of a correlation of kidney function. In other words, it is largely a functional question. Possibly the best authority in this country on this subject is Dr. William C. Quinby, of Boston. He has performed only a few such operations, it is true, but more than anyone else over here, and the results have been such as to make us consider them fairly successful. The hydronephroses of the upper ureter caused by aberrant vessels (in many cases coming from the lower portion of the kidney

and crossing over the ureter, causing stricture) are the cases in which he has been particularly interested. In some 8 or 10 cases he has done what we have come to know as ureteral implantation. I do not know that he has reasoned out why it has worked so well. Of course he has implanted the ureter mainly with the idea of not cutting off the aberrant artery, which destroys a certain amount of kidney parenchyma, and we would prefer to avoid this if possible. But we can cut off the ureter and implant it in the lower part of the kidney pelvis. In most cases the two symptoms of pain and infection in the kidney are very well controlled by this operation. Apparently the reason for the success of the operation was that the ureter was implanted in the lower part of the kidney pelvis, establishing good drainage for the kidney pelvis.

I was interested to hear Professor von Lichtenberg speak of Mikulicz's operation, i.e., cutting the ureter one way and closing it another way. Inasmuch as mine has been a very limited experience in this direction, I would like to hear more of this operation, as I was under the impression that the results obtained had been rather poor. Quinby reports several cases in which he had to do a further operation, several times a nephrectomy, where the Mikulicz operation did not succeed in overcoming the obstruction. Because of the infrequency with which one is confronted with this proposition, I feel that the best procedure is that which Quinby has done so well, i.e., cut off the ureter and transplant it in the lower part of the kidney pelvis, suture up the redundant kidney pelvis if necessary, and depend upon the reimplanted ureter to do the work, rather than performing the Mikulicz operation or doing a dilatation of the ureter, especially in cases where the stricture is in the upper part of the ureter.

Dr. Joseph F. McCarthy: My experience with this conservative operation for hydronephrosis has been limited largely to aberrant vessels and kinks. What I have to say beyond that is largely speculative. I think that in this country, except in a very few clinics and in the hands of a limited number of operators, conservative operations for hydronephrosis have been rather rare. Dr. von Lichtenberg's paper is valuable in that it will focus the minds of our surgical urologists on the greater possibilities of this operative procedure. On the other hand, except in the hands of urological surgeons who have had thorough surgical training, it would not be wise to subject many cases to this type of surgery. In other words, caution should be observed lest we allow the operation to be performed offhand.

I think we might bring out Professor von Lichtenberg's ideas a little more if we requested him to elaborate further on his diagnostic procedures. Thus when he states that the dye output is not a true indication of a diseased process of the kidney, I should like to know what technical steps he employs in arriving at the true interpretation of the condition, or if such true interpretation is possible. That a kidney will be restored in many seemingly advanced cases of suspected kidney destruction can easily be verified. I have in mind a case in which the ureter was completely blocked by a large calculus for several months, where we were quite certain a secondary nephrectomy must be performed. I have been surprised to find that after removal of the obstructing stone, subsequent dye tests demonstrated good kidney function. I would like to know if Professor von Lichtenberg completely fills the renal pelvis with opaque media in determining the extent of the hydronephrosis. Also, how much he relies on pain as a manifestation of the filling capacity of the renal pelvis; and whether he first estimates the capacity of the renal pelvis with a neutral solution, prior to pyelographic study.

It seems to me this paper of Professor von Lichtenberg will doubtless result in our looking more closely into the precise pathology of such cases, and certainly proving the capacity of the pelvis on the other side, not only functionally but pyelographically.

Dr. C. Rutherford O'Crowley: Professor von Lichtenberg's conception of conservative surgery certainly opens a way to prevent promiscuous nephrectomy in all cases diagnosed as hydronephrosis. But I think that it requires plastic work on the ureter and pelvis; and even if we wished to follow the principle of Heineke-Mikulicz, it requires someone who has had a great deal of experience in kidney surgery. The Mayo's, following the classical operation, have reported about 59 cases, one-third of which came to subsequent nephrectomy.

I think the term urinary constipation is a very good one, and that while it appears

to be a very generic and common term, it is really very deep and has many ramifications which must be studied very carefully.

As Dr. Barringer and Dr. McCarthy have said, we do not know how far function will be restored after doing partial work on such cases as described by Professor von Lichtenberg. I do not know, of course, for what periods of time following operation these cases were studied, and to what extent they increased in function. I should like to know if some have gone on and become worse, and whether they have been compelled through pain and other symptoms to have a secondary nephrectomy. This has been the experience of others because of these symptoms.

Dr. Alfred T. Osgood: Up to fairly recent times, when a diagnosis of abnormal distention of the renal pelvis had been made the surgical indication was an immediate nephrectomy. I think every surgeon is now doing conservative surgery on the kidney, and looking for new procedures in that direction. This paper has offered us a very distinct and very important contribution to that end. While the conservative operation Professor von Lichtenberg mentions has been done from time to time for many years, to consider the whole subject of hydronephrosis as an indication for conservative measures right from the start, as he does, is a very important standpoint for all of us to take.

I should be very much interested, as is Dr. McCarthy, in knowing the diagnostic means by which he comes to the conclusion as to the proper procedure to follow. As I understand it, he comes to his conclusions at operation by a study of the conditions he finds, and proceeds accordingly.

It is only in the last few years that we have had any knowledge of the possibility of recovery of the ureter and pelvis after a very marked dilatation. A few years ago I found it very interesting to note a very markedly dilated ureter which, by simply dilating the lower extremity, as we all do, on later pyelography proved to have returned to normal size after protracted dilatation of many years. The only treatment was a simple dilatation of an obstructive stricture, caused originally by a calculus in this case. I should like to know if the pelvis will go back to normal in many cases after such conservative surgery as Professor von Lichtenberg mentions.

However, to proceed in every case of hydronephrosis with an idea of conservative surgery is a very important contribution to our surgical knowledge.

Dr. Nathaniel P. Rathbun: It seems to me that Professor von Lichtenberg is again doing what he did twenty-five years ago, blazing a trail. At that time he was the first to do pyelograms and to impress upon us the importance of their interpretation; and now he stands in the same light as regards conservative surgery.

It is a simple thing to take out a kidney which is giving trouble; anybody can do that. But the real urologist conserves the kidney.

Many patients come to us not because of hydronephrosis, but with infection and bladder symptoms, and the enlargement is only noticed when attention is called to it. If we could recognize it earlier, more kidneys would be conserved.

The most important aid in diagnosis is Professor von Lichtenberg's great contribution, the pyelogram. A proper interpretation of the pyelogram gives us a better idea of the future function of the organ than dye tests, as the amount of renal cortex and renal destruction can thus be determined, and the kidney may thus be saved; though in many cases dye tests lead to a saving of the kidney. We find important obstructive lesions at the root of most hydronephrosis cases.

We do not see as many strictures of the ureter as we did many years ago. There is no question, however, that quite a number are seen even today, in the lower ureter, call it stricture of whatever you like. The fact remains that there is some obstruction to the outflow, of urine which causes the hydronephrosis, an obstruction which can be relieved by dilatation of the ureter, and to my mind this treatment is an important item in handling these cases.

I have had very little experience in conservative surgery on the kidney pelvis except the Mikulicz operation. It is easy to perform, and I have had excellent results in the way of relief from symptoms. I have seen a large, dilated pelvis which on future pyelograms showed it had not contracted much, as it was still large, but better drainage had been established and other symptoms relieved.

I would appreciate it very much if in his closing discussion Professor von Lichtenberg

would dilate further upon some of his operative measures. I am particularly interested in the anomalous vessel cases producing kinks at the ureteropelvic junction. I confess that this is always a problem in my hands. Should we tie off the vessels and take a chance on disturbance in the renal function? In resecting the ureter and transplanting it into the pelvis, I have had no experience. I am also interested in the Professor's opinion of the importance of draining the kidney temporarily through a nephrotomy or pyelotomy incision, in the course of an operation on the kidney pelvis.

Dr. A. Raymond Stevens: Hydronephrosis, as it is commonly called, can be caused, obviously, by obstructions in the ureteral wall, within its lumen, or by outside obstructions. I recently reviewed such cases in the service at Bellevue Hospital, and will speak of a few bearing on this discussion.

I find that I have tied aberrant vessels in 4 cases. In every one of those the vessels have been small, and I felt convinced that they did not feed a very large portion of kidney substance. Almost all were well surrounded with fibrous tissue. If I should come across an aberrant vessel which was large, and in a case in which I did not feel justified in doing nephrectomy, I surely would want to cut the ureter, pass it under the obstructing vessels and then reimplant it in the pelvis. So far, however, I have had no cases of this character to deal with.

The point I particularly wish to stress is that after the aberrant artery and vein have been cut, it is important to relieve the upper ureter of fibrous tissue at the ureteropelvic junction, and to leave the ureter coming out of the lower pole of the kidney pelvis. In the 4 cases which I have mentioned this procedure was followed, and in most instances I also did a nephropexy.

There were 3 instances of obstruction due to peripelvic inflammatory tissue without aberrant vessels. In those cases this tissue was carefully dissected away and excised.

The group which I would like to hear Professor von Lichtenberg tell us more about is that in which obstruction is caused by some neurogenic process. In that group I presume would fall the condition spoken of as urinary constipation. It is the etiology and therapy of the latter cases that I am interested in.

Dr. Clyde L. Deming (Yale University): Hydronephrosis has indeed been an absorbing study with us at New Haven, and one which has proved perplexing. We have followed with interest the experimental work of Dr. Frank Hinman on the Pacific Coast, and the clinical work of Dr. William C. Quinby in Boston. One observation which has not been mentioned here, and one which I have observed in clinical work and recently in experimental work on hydronephrosis, is that when there is an obstruction at the lower end of the ureter we see first a dilatation of the calices; and when the obstruction is in the upper ureter, we see first a dilatation of the pelvis. These observations are not wholly mine, but those of Dr. W. F. Braasch and others in this country. I would like to know if Professor von Lichtenberg has noted this, and can explain this point.

Dr. David L. Simon (Pittsburgh): Last Fall I had the pleasure of being Professor von Lichtenberg's guest at his clinic, and of seeing a few of the results of his work in the conservative treatment of hydronephrosis. I also saw similar results at the clinic of Illyés, in Budapest, where the same procedure is followed. I am sure that when the subject is fully understood (although it is not a new one) there will be many of us who will attempt conservative surgery of the kidney.

Dr. McCarthy has said that the danger is that men who do not operate frequently may adopt this treatment. I agree with him in this, but think the trouble is not so much with the operation as in understanding the conditions and diagnostic procedures necessary to determine in what class of cases it should be done.

Professor von Lichtenberg (Closing): I would like to emphasize that every surgeon can do a nephrectomy, but to save an important organ such as the kidney is reserved for urologists. Only a little kidney tissue is necessary to maintain life; and the aim of treatment is not cure and complete restitution, but the conservation of the utmost kidney function. In all cases where a little function still remains, therefore, we usually attempt to save the kidney. The importance of a correct interpretation of the pyelogram is also worthy of the utmost consideration.

Answering Dr. Deming concerning dilatation of the calices in stricture of the lower part of the ureter, and dilatation of the kidney pelvis in stricture of the upper part: I do not

quite agree with this. Dilatation depends on the anatomy of the genitourinary organs.

Capacity is not a morphological question, but more a matter of function. Sometimes 4 c.c. is sufficient to fill the normal kidney, then again we need up to 10 c.c. To determine the normal capacity, it is necessary to observe when the kidney pelvis empties itself; and it needs about three or four contractions of the pelvis. If the pelvis does not empty in three or four contractions, we have urinary retention.

Concerning the Mikulicz operation I would like to say that I have always had good results. Accessory vessels are abnormalities. They have little function and little importance to the kidney. In operating on these cases with accessory vessels I am against implantation of the ureter, because implantation causes a disturbance of innervation.

Adhesions should always be freed. This is very important also in cases of nephrolithiasis. Sometimes this procedure is sufficient to relieve the disease.

In conclusion let me say that the conservative method of operation depends on the pathological picture and a correct diagnosis, which should be complete before the operation is started.

INDIRECT INGUINAL HERNIA*

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INTRODUCTION

NO matter how difficult or obscure an operation may be, if the surgeon is well grounded in anatomy, he will never lose his bearings.

Much has been written about inguinal hernia, but, unfortunately, a large number of the writers have paid little or no attention to the embryology, anatomy, and mechanics of this region. To understand this interesting abdominal wall defect, one must be well acquainted with all the details of its structure and mechanics, as well as the details, macroscopic and microscopic, of the reparative process going on after operative repair.

The operating room of a large hospital is inadequate as a teaching medium for surgery. Such careful dissection as must be done to learn the pathology of hernia is impossible on the living. Hence, an extensive and intensive training obtained in the dissecting room is indeed an indispensable adjunct. Unfortunately, most surgeons have not dissected since their days at medical school. Consequently, hernias are corrected or repaired according to the rule of thumb memorized from various textbooks on surgical technique without understanding the reason why.

HISTORY

Just a word on the history and comparative anatomy of hernia. The physical defect known as inguinal hernia was recognized before the Christian era. History records a Phoenician statuette about 900 B.C. showing a double inguinal hernia. In the fourth century Hippocrates wrote an article on hernia. The first physician to operate on hernia was Celsus, a Roman who lived in the first century, and who probably gleaned much from his dissection of executed criminals and his military experiences, succeeded in ligating a hernial sac after isolating it through an incision, and removed the redundant portion. It is rather interesting that at present some believe that in many hernias such a procedure is sufficient. He did not open the sac. And, so, we may continue down the line mentioning such names as Oribaeus, another Roman, Paul of Aegina, a Greek of the seventh century, Guy de Chauliac, a famous French surgeon of the fourteenth century, Ambroise Paré in the sixteenth century, and Langenbeck in the nineteenth century. More recently we have such familiar names as Russel, Bassini, Turner, Gallie, MacEwen, and a host of others too numerous to mention. Each has contributed his share of work. Most have been concerned with the practical surgical aspect. Few have delved into the anatomy and physiology of the inguinal canal. Turner has endeavored to put the condition on a sound basis.

ANATOMY AND EMBRYOLOGY

The most vital structure involved in the etiology of inguinal hernia and again concerned in the reparative surgical process, is the mesodermal tissue. It is common knowledge that blood vessels, muscles, ligaments, bone, and all connective tissue elements are fundamentally mesodermal cells. All these differentiated forms of mesoderm, in order to heal after injury, accidental or intentional (and by intentional I mean operative intervention) must revert back to, or be replaced by the original embryonal cell. In the embryo fwe have a division of the mesoderm into our parts:

1. *Paraxial mesoderm*, from which the voluntary musculature is derived.

2. *Somatic mesoderm*, which, with an ectodermic covering, forms the outer wall of the coelom.

* Submitted for publication April 18, 1929. The author expresses his thanks to Dr. Fradkin of the House Staff of the Jewish Hospital, Brooklyn, or his kind assistance.

3. *Intermediate cell mass*, in which are developed the renal and genital organs.

4. *Splanchnic mesoderm*, which is the cleft between the layers of the mesoderm, in the coelomic space.

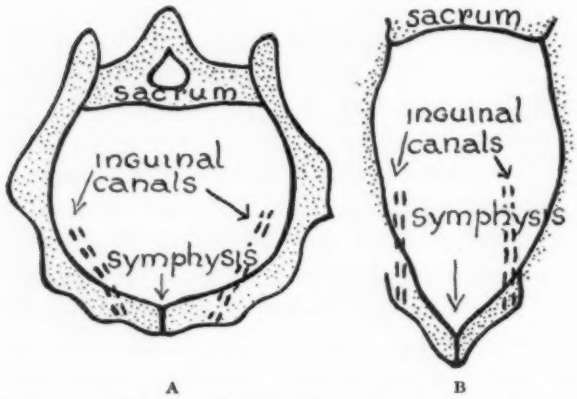


FIG. 1. A. Pelvis and inguinal canal in man. B. Corresponding form in pronograde primates. (After Keith.)

In spite of these various ramifications of the mesodermic system, with perhaps the specialization of each branch, they all respond to injury in the same way, to wit, as has already been mentioned, reversion back to, or replacement by, the original mesodermal cell, and only then will healing take place. For the highly refined adult or ultimate cells sacrifice their power of regeneration or healing by virtue of their specialization. This holds true for bone, plain muscle, and to a great extent striated muscle, unless the lesion or injury be minimal, and also in aponeuroses, and fascial structures.

Just to digress for a few moments on the comparative anatomy and gross embryology of the inguinal canal.

It is known that inguinal hernia does not occur in the anthropoid apes, a species that shares the orthograde posture with man. The lower extremity of man has undergone extensive structural alterations because of his peculiar plantigrade progression. As a result, it is natural to expect skeletal and muscular changes in the region of the pelvis and thigh. The groin, as we may expect and soon learn, becomes weakened and thus is the frequent site of hernia. In fact, it has been remarked that due to certain structural changes in man resulting from his adaptation to upright progression, inguinal hernia may be considered a human peculiarity. To quote Keith, man's susceptibility to hernia is due to the following:

1. The unique form of the inguinal ligament, which is scarcely developed in any other animal.

2. The conjoined parts of the internal oblique and transversalis muscles in man are not very muscular.

3. The human manner of walking and the great size of the head of the human child at birth require a wide pelvis. All mammals adapted to the pronograde posture have a narrow pelvis, and, therefore, a narrow anterior abdominal wall, through which the inguinal canal passes very obliquely. In man the inguinal canal is more direct, and, therefore, affords greater opportunity for the escape of the abdominal contents.

4. Due to the width of man's anterior abdominal wall and the size of the space between the edge of the pelvis and the inguinal (Poupart's) ligament, the crural passage is greater in man than in any other animal. (See Fig. 1.)

5. The most important factor in the causation of hernia in man is the compression to which the abdominal contents are subjected by contraction of the abdominal parietes during strenuous efforts.

The obliquity, such as it is, of the inguinal canal in man is a natural obstacle to the formation of hernia because an increase in intra-abdominal tension forces the walls of the inguinal canal more closely together. This is brought about by the muscular action which is a *sine qua non* of abdominal compression.

The anatomy of the inguinal region is bound up with the anatomy of the abdominal wall. The following structures are involved and some will be briefly reviewed:

1. Musculature
   - Rectus abdominalis
   - External oblique
   - Internal oblique
   - Transversus abdominalis
   - Cremaster

2. Aponeuroses or fascial	Inguinal ligament (Poupart's)	
	Gimbernat's ligament (lacunar).	
	Reflex inguinal ligament	
	Aponeurosis of external oblique	
	Transversalis fascia	
	Scarpa's fascia	
3. Abdominal rings	Abdominal	
	Subcutaneous abdomianl ring or external abdominal ring	
4. Inguinal canal		
5. Cord and its component parts	Vas	
	Spermatic arteries	Internal
		External
	Pampiniform plexus of veins	
	Genitocrural nerve	
6. Blood vessels	Deep epigastric	
	External circumflex iliac	
	Superficial epigastric	
7. Nerves	Iliohypogastric	
	Ilioinguinal	
8. Peritoneum		

It is unnecessary in this short paper to review in detail the intricate anatomy of those structures which go to make up the inguinal region. However, it is quite pertinent to consider briefly a few important facts concerning the inguinal rings and the peritoneum in this region.

Abdominal Rings. As stated above, there are two abdominal rings, one at the lateral end of the inguinal canal, called the abdominal inguinal ring, and one at the medial extremity, called the subcutaneous or external abdominal ring.

The abdominal inguinal ring (internal abdominal) is located in the fascia transversalis ½ in. above the inguinal ligament, midway between the anterior-superior spine of the ilium and the pubic symphysis. It is bounded medially by the ligamentum interfoveolare. It permits exit of the cord from the abdominal cavity.

Subcutaneous or External Abdominal Ring. The cord emerges from the abdominal wall through this hiatus. It is triangular in shape, and is formed by the decussating fibers of the external oblique aponeurosis. The spine and the crest of the pubis form its base. It lies just lateral to and above the pubic tubercle and is bounded above by the superior crus (fibers of the external oblique aponeurosis) which are attached to the pubic tubercle, and below by the inferior crus, whose fibers are attached to the anterior surface

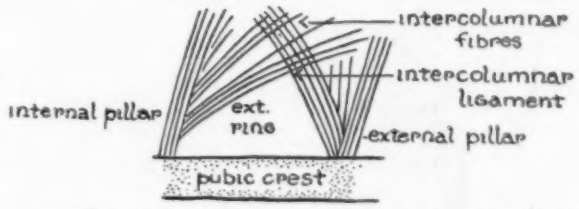


Fig. 2. Subcutaneous or external abdominal inguinal ring. (After Turner.)

of the symphysis pubis. Some of the fibers of the external oblique at the lateral aspect or apex of this triangular ring run transversely. The margins of this ring arch over the spermatic cord at its emergence from the inguinal canal (See Fig. 2.)

Peritoneum. As is known, the umbilical arteries, which lie medial to the testis, lift up a peritoneal fold so that the gland projects into a small peritoneal fossa. At about the seventh month of gestation this fossa or depression lies opposite the abdominal inguinal ring. Sometime during the eighth month it invades the inguinal canal. The peritoneal process becomes elongated and forms the processus vaginalis. The processus vaginalis undergoes various changes in this process of elongation, as shown in the diagrams. (See Fig. 3.)

From a study of the diagrams in Figure 3 it is readily seen what different forms the processus vaginalis may assume. With careful study we can readily understand the various types of hernia and hydrocele.

As may be deduced from the anatomy of the entire inguinal region, its physiology is bound up in the mechanics of the entire abdomen. All muscular action of any of the abdominal muscles, associated or not associated with increased or diminished intra-abdominal pressure, directly concerns the structures of the inguinal canal. These component parts are not inanimate structures, as one would infer from the various operative procedures designed to correct herniae. But just as one may study the actions of the pyloric

sphincter, and the stomach musculature with its internal, middle and external coats, so must the action of the muscles have such and such a muscular action tending to alter the size and shape of the abdominal inguinal ring. But the external

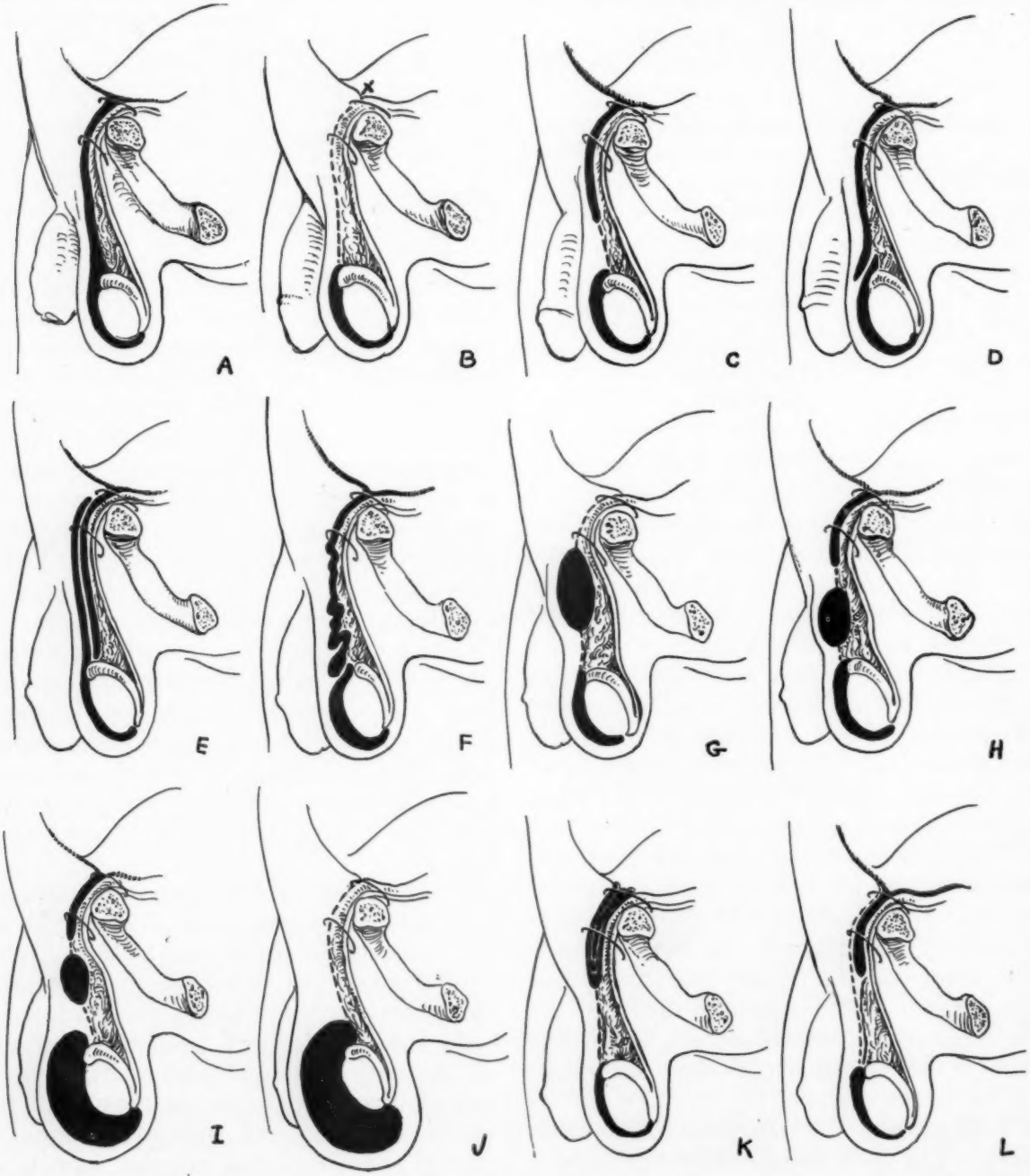


Fig. 3. A. Patent vaginal process. Fetal type. B. Normal type. C. Partially obliterated processus. D. Similar to "C." E. Longitudinal closure of processus. F. Similar to "D" with valve-like constrictions. G. Encysted hydrocele of cord. H. Similar to "G" with patent processus. I. Similar to "H" with hydrocele in tunica vag. J. Hydrocele of tunical vaginalis. K. Encysted hernia. Closed abdom. end of processus invaginated into patent funicular process. L. Similar to "B" with herniation alongside partially closed processus.

culature of the groin be visualized. One often reads the statement that the internal oblique and transversus abdominalis muscle oblique aponeurosis, as well as the inguinal ligament, is also involved in all the muscular contractions in this region. For

are not these structures really prolongations of the enveloping muscular structure, the external oblique muscle of the abdomen? Similarly, who will gainsay the fact that the latissimus dorsi and the external oblique have important functions to perform in preventing a hernia in the triangle of Petit? Take the matter of umbilical hernia (infantile). The failure of the transversalis fascia to close this defect is surely not only a static one. Muscular action comes into play to close this opening, or at least to diminish its size, after the shrinkage of the umbilical cord and its contents.

Normally, the abdominal ring, as well as the inguinal canal, is a potential space. The cord fills up the opening of the ring and the canal. The muscular action of the internal oblique, transversus abdominalis muscle with the assistance of the ligamentum interfoveolare and muscle is indeed a potent factor in keeping the abdominal inguinal ring from enlarging. The external oblique aponeurosis overlying this opening acts as a pad which tightens with every effort at straining, associated with lifting or defecating. All these musculo-aponeurotic contractions are normal physiological purposeful movements designed to prevent protrusion of the abdominal contents.

Farther down the inguinal canal we come to the external abdominal ring, or the subcutaneous abdominal ring. As has been noted, the interlacing aponeurotic fibers in their pull transmitted through the external oblique musculature, act to diminish the size of this lumen, by approximating the crura, and shorten the anteroposterior diameter of the inguinal canal, by approaching the inguinal ligament. What a wonderful attempt to overcome man's weakess in the inguinal region! With our plantigrade progression and orthograde posture and its resultant weakness in the abdominal wall, nature has made an attempt to correct a potential defect by:

1. Obliquity of the inguinal canal.

2. Covering a weakness at the abdominal ring by the strong external oblique aponeurosis.

3. Protecting the subcutaneous abdominal ring by the firm transversalis fascia behind it.

By careful dissection, one can also discern the fibers of the external oblique aponeurosis of one side crossing to the crura of the opposite subcutaneous ring, so that the contractions of both rings may work harmoniously.

SURGICAL ANATOMY

One has only to have a patient cough while inserting the examining finger into the external abdominal ring to observe the firm contractile power of the crura and the approximating action of the external oblique toward the posterior wall of the inguinal canal. Or under local block or infiltrative anesthesia, with the internal ring exposed to view, when the patient coughs, it is interesting to note the contractile power of the internal oblique and transversus abdominalis muscles. The same applies to the walls of the subcutaneous abdominal ring. The increased intra-abdominal pressure naturally helps to approximate the posterior inguinal wall to the anterior wall or external oblique aponeurosis.

In view of all these facts, how can one believe that the ordinary indirect inguinal hernia is acquired? How more logical and reasonable it is to accept the saccular theory so wonderfully expounded by Russell of Australia? A peritoneal protrusion, small perhaps to begin with, acts as an entering wedge. (See Fig. 4, B and C.) Increased abdominal tension through this sac pushes aside the walls of the abdominal ring and gradually weakens it. In time the sac elongates and forces its way down toward the external ring, where a similar action takes place. The aponeurotic fibers of the external oblique gradually yield. In time the examining finger does not find a firm contracting external ring, nor does one observe good strong contracting

internal oblique and transversalis muscles. Instead, we perceive and feel frayed-out, weak muscle and fascial structures, caused by overstretching, so that, in time, we have poor substitutes for what originally were good supporting tissues.

As for the surgical anatomy of the hernial sac or protrusion, we may trace its position and development quite simply. In its descent with the testis, the peritoneal pouch, consisting of the tunica vaginalis and its funicular process, pushes before it, taking in turn a derivative of the various layers for one of its coverings, as already mentioned (see Fig. 4, A, B, C):

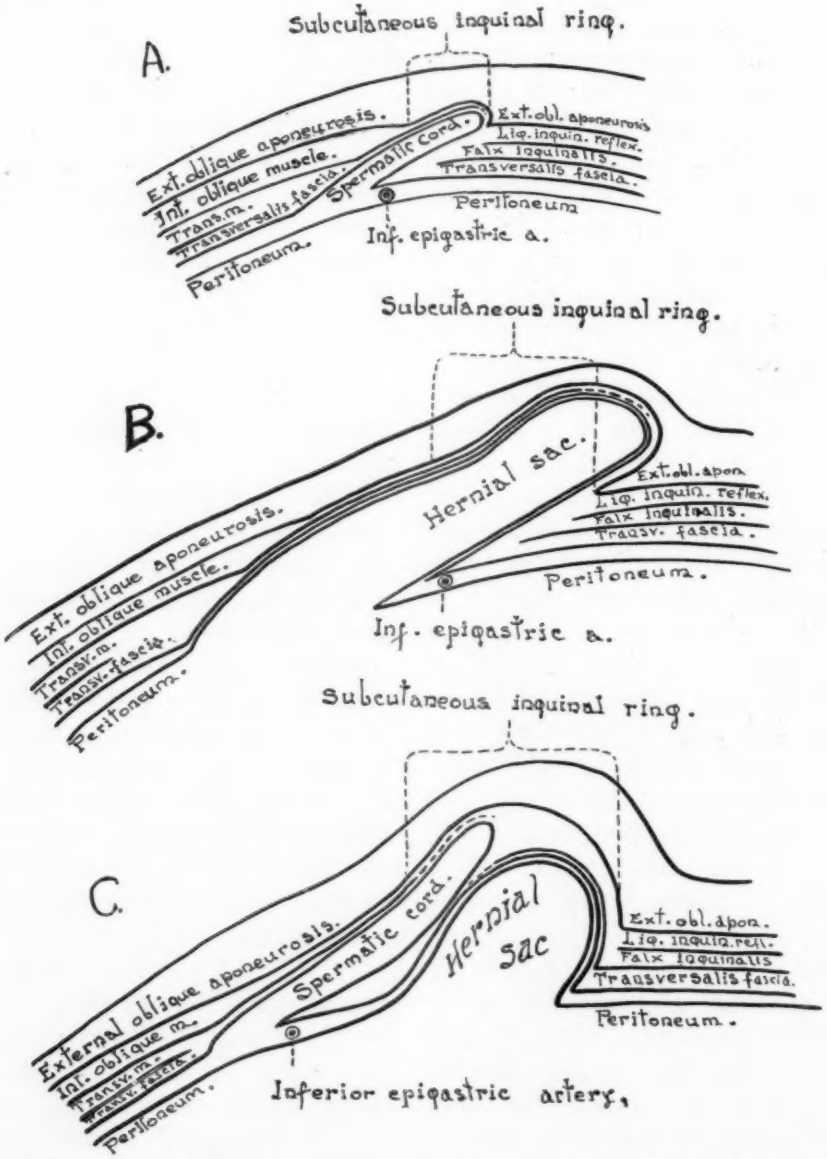
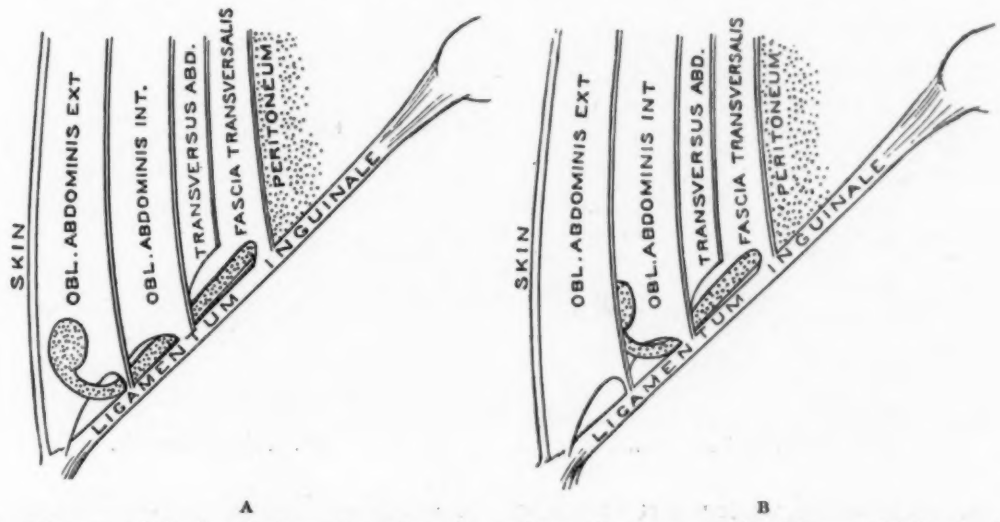


FIG. 4. A. Normal condition showing coverings of cord. B. Oblique or indirect inguinal hernia. C. Direct inguinal hernia. (After Beesly and Johnston.)

(1) the internal spermatic or infundibuliform fascia; (2) the cremasteric fascia; (3) the external spermatic fascia, and (4) the superficial fascia. The peritoneal pouch, as we can readily see, may become completely obliterated above the tunica vaginalis to the internal or abdominal inguinal ring. Such would be the ideal process, presenting perhaps on the inner

aspect of the abdomen a dimple in the region of the inguinal ring. (See Fig. 3 B.) However, we may get closure at any point



A B

FIG. 5. A. Diagram of the inguinal canal to show the position of an extra-parietal interstitial hernia. Portions of the different layers of the abdominal wall have been removed. The patent processus vaginalis and the peritoneum are shown shaded. B. Diagram of inguinal canal to show the position of an interparietal interstitial hernia. Portions of the different layers of the abdominal wall have been removed. The patent processus vaginalis and the peritoneum are shown shaded. (After Beesly and Johnston.)

in the inguinal canal. In addition, the agglutination process may be so imperfect that it permits of protrusion of the abdominal contents as a result of straining. In this event, we see how imperfect nature was in its handiwork.

In another class of open funicular processes one finds the sac insinuating itself between the various layers of the abdominal wall. Consequently, one may find the hernial sac or diverticulum between any two layers of the abdominal wall structure, giving what is called an interstitial or parietal hernia. This is really a diverticulum of the original open funicular process which grows between the abdominal wall layers as a result of increased pressure, plus, perhaps, traction because of adhesions to the surrounding tissues. The sac then grows in the path of least resistance. (See Fig. 5.)

A third group of cases is those in which together with an open funicular process there is, in adition, a large pouch of peritoneal tissue communicating with the tunica vaginalis, often filled with fluid, in other words, a form of hydrocele. (See Fig. 3 E.) That part of the funicular process which has become obliterated is very difficult to dissect, because of the fineness of its texture and the intimacy with which it is connected with the other structures of the cord. Dissection of an obliterated peritoneal process is well-nigh impossible. As for the peritoneal pouch extending from and communicating with the tunica vaginalis, it probably is a result of an adhesion between the original tunica vaginalis and the abdominal wall in its descent into the scrotum, thereby permitting a traction diverticulum to form. (See Fig. 3 I.)

CLASSIFICATION

As a result of these few words, one readily sees how sinple it is to classify the various types of indirect inguinal (oblique) hernia:

1. *Congenital.*
   - A. (1) *Incomplete*, where, due to partial failure of closure of the funicular process, the hernia cannot pass into the testicular portion of the tunica vaginalis. (See Fig. 3, C, D, E, F.)
   - (2) *Complete*, where, due to total failure of closure, the hernia

is free to pass into the testicular portion of the tunica vaginalis. (See Fig. 3 A.)

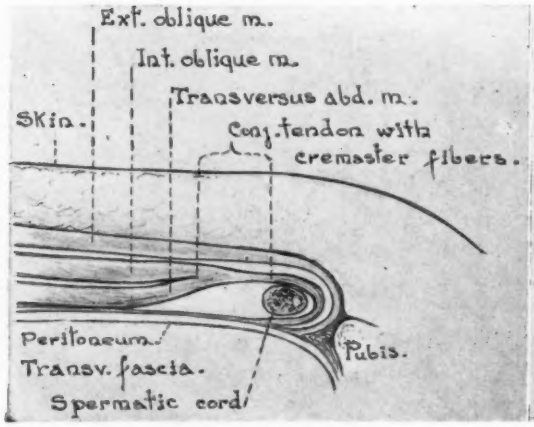


Fig. 6. Normal inguinal canal.

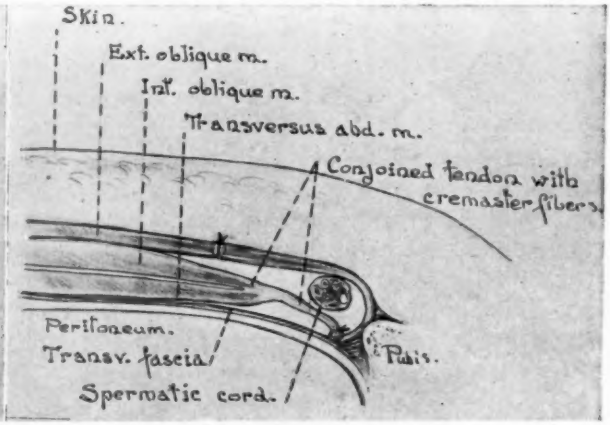


Fig. 7. Bassini repair.

B. *Interstitial*, where, often with an incomplete descent of the testis, a portion of the funicular process is caught by some layer of the abdominal wall, thus permitting the insinuation of the sac between any two layers. (See Fig. 5.)

II. *Infantile.* In this type the funicular process has been closed, but, due to faulty agglutination, the increased abdominal tension tends to extrude the contents into the incompletely obliterated sac, thereby forming a hernia during infancy. It really is a congenital hernia which is late in appearing.

In all cases where a hernia is not noted till later in life, it probably is one of the infantile type, the hernial formation awaiting a propitious moment when the strain arrives. In those children in whom a hernial protrusion is cured without operative intervention, the condition probably was one of the latter, or infantile type, in which the agglutination process completes itself, or rather becomes firmer with age, and muscular development prevents the growth of what really is a slight protrusion at the abdominal inguinal ring.

It can readily be seen that there is no such entity as acquired inguinal hernia, for the intraabdominal pressure is surely too weak to overcome the counteracting forces in the prevention of hernia. Just a small peritoneal protrusion at the site of the mouth of the funicular process is enough to permit the entering wedge and then the hernial formation.

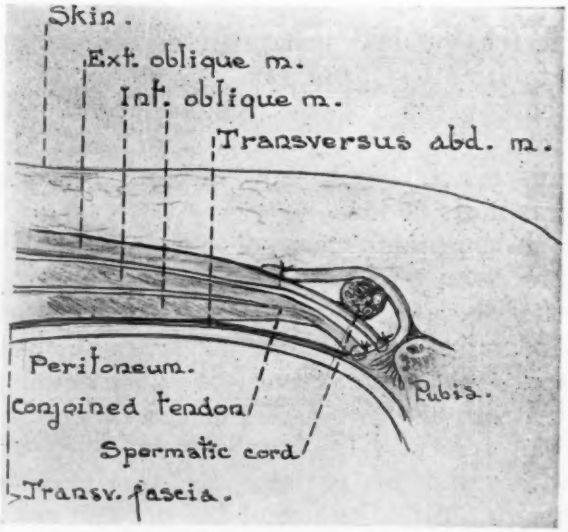


Fig. 8. Willys-Andrews method.

To quote Ogilvie in his recent article on inguinal hernia:

Practically at operation, two varieties of sac are familiar to the surgeon. The common type lies anterior to the structures of the cord: in transverse section the lumen of the sac would resemble a horse-shoe, the cord being invaginated into it as if on a mesentery. The vessels, and still more the vas itself, are firmly

TABLE 1

CHILDREN

Name	Age	Color	Sex	Chief complaint	Duration	Findings	Operation	Type
B.	4 yrs.	W.	M.	Mass and pain in left inguinal region	1 mo.	Left indirect inguinal hernia. Sac 2½ in., containing omentum	Bassini repair	C
B.	5 weeks	W.	M.	Mass and pain in right scrotum	12 hrs.	Incarcerated right indirect inguinal hernia containing loop of bowel. Congenital hydrocele	Bassini-Jaboulay	I without encysted hydrocele
B.	7 yrs.	W.	M.	Mass and pain in left scrotum	1 yr.	Left indirect inguinal and scrotal hernia, reducible. Small hydrocele	Bassini repair	I
B.	7 yrs.	W.	M.	Mass in left inguinal region	2 yrs.	Left indirect inguinal hernia. Sac 2 in. long. Postoperative adhesions	Bassini repair. Cord sup. to external oblique fascia	C
C.	7 yrs.	W.	M.	Mass in each inguinal region	Several years	Large right indirect inguinal hernia. Sac 2½ in. No definite sac on left side	Bassini repair, bilateral	C
E.	6 yrs.	W.	M.	Mass, bilateral, in inguinal region	1 yr.	Congenital undescended testicle, and congenital inguinal hernia. Testicle at external ring on right side. Sac 1 in. long. Testicle inside of external ring on left. Sac 1½ in. long	Bassini repair. Bevan operation	Both class C
G.	7 weeks	W.	M.	Mass in right inguinal region	3 weeks	Right indirect inguinal hernia. Undescended testicle. Hydrocele of cord	Bassini-Jaboulay	H
J.	3½ mos.	W.	M.	Mass, bilateral, inguinal region	2 mos.	Bilateral indirect inguinal hernia. Large sacs	Sac ligation, bilateral	C
M.	9 mos.	W.	M.	Mass in right inguinal region, extending into scrotum	3 days	Right congenital indirect inguinal hernia. Sac 2 in. long, containing omentum	Sac ligation	D
R.	10 weeks	W.	M.	Mass in right groin, irreducible	20 hrs.	Strangulated indirect inguinal hernia, containing 2 in. of discolored intestine at ring	Sac ligation	C
S.	2½ yrs.	B.	M.	Mass in left scrotal region	2 yrs.	Congenital indirect inguinal hernia. Sac 2½ in. long, descending into scrotum; contained adhesions, omentum and intestine	Willys-Andrew repair	D
S.	4½ yrs.	W.	M.	Mass and pain in left groin	9 mos.	Congenital indirect inguinal hernia. Undescended testicle. Sac 2 in. long, containing omentum	Willys-Andrew hernioplasty	C
S.	7 yrs.	W.	M.	Mass in right inguinal region	2 mos.	Right indirect inguinal hernia. Sac descended to external ring; contained omentum and serous fluid	Bassini hernioplasty	C

TABLE 1 (*Continued*)

CHILDREN

Name	Age	Color	Sex	Chief complaint	Duration	Findings	Operation	Type
S.	5 weeks	W.	M.	Mass and pain in right inguinal region	1 day	Indirect inguinal hernia, incarcerated. Sac 2½ in. long, containing omentum and serous fluid. Hydrocele of cord	Bassini-Jaboulay	H
T.	16½ mos.	W.	M.	Mass and pain in right inguinal region	16 mos.	Congenital indirect inguinal hernia, incarcerated. Sac contained testicle, much straw-colored fluid, and omentum.	Sac ligation	A
W.	4½ yrs.	W.	M.	Mass in right groin and enlargement of scrotum	1 yr.	Large indirect inguinal hernia	Bassini herniorrhaphy	C
K.	9 yrs.	W.	M.	Mass and pain in right inguinal region	3½ yrs.	Indirect inguinal hernia with incarceration of omentum	Bassini herniorrhaphy	C
S.	9 mos.	W.	M.	Mass in right inguinal region	1 week	Indirect inguinal hernia. Congenital sac, 1 in. long, containing omentum	Bassini repair because of attenuated tissues	C
K.	12 yrs.	W.	M.	Mass and pain in right groin	2 yrs.	Indirect inguinal hernia. Encysted hydrocele of cord. Hydrocele of testis	Bassini-Jaboulay.	I
K.	7½ yrs.	W.	F.	Mass in right inguinal region and pain	5 yrs. 1 yr.	Indirect inguinal hernia	Bassini repair	C
ADULTS								
J. C.	28	W.	M.	Mass and pain in left inguinal region	1 yr.	Indirect inguinal hernia, left. Sac 3 in. long. Indirect inguinal hernia, right. Sac 1 in. long.	Bilateral Bassini and transplantation of cord	C
J. F.	54	W.	M.	Mass in right inguinal region. Pain in right inguinal region	14 yrs. 2 mos.	Large sac with numerous lobulations and adhesions. Indirect and partial direct hernia	Bassini repair with cord transplantation	F
E. F.	29	W.	M.	Mass in right inguinal region with pain. Mass and pain in left inguinal region	3 mos. 3 mos. 1 wk. 2 days	Left-sac 1½ in. long, devoid of contents. Right-enlarged ring. No sac	Bassini repair, bilateral, with cord transplantation	C
R. F.	24	W.	M.	Mass in left groin; scrotal mass	4 yrs. 2 yrs.	Indirect inguinal hernia. No sac contents	Bassini repair	C
M. F.	25	W.	M.	Mass and pain in left inguinal region	1½ yrs.	Large indirect inguinal hernia. Sac 2½ in. long, containing omentum. Veins enlarged along cord. Sac adherent to surrounding structures	Bassini repair with transplanation of cord	C
J. G.	36	W.	M.	Mass in left scrotal region. Pain on exertion	2 yrs.	Fascia of external oblique over-stretched and thin. Conjoined tendon very thin. Sac long, continuous with tunica vaginalis of testicle, and contained ad herent omentum	Bassini repair with usual cord transplantation. Jaboulay operation	A

TABLE 1 (*Continued*)

ADULTS

Name	Age	Color	Sex	Chief complaint	Duration	Findings	Operation	Type
L. G.	19	W.	M.	Mass in right inguinal region. Pain in right inguinal	12 yrs. 1 yr.	Large indirect inguinal hernia with sac about 4 in. long. Thick end adherent. Contained omentum	Bassini with cord transplantation	D
H. G.	25	W.	M.	Mass in left inguinal region	5 yrs.	Large indirect congenital hernia with constriction of sac at junction of cord and testicle, forming hydrocele of testicle. Sac contained omentum and intestine. Large varicocele	Bassini-Willys-Andrew-Jaboulay	D
S. G.	67	W.	M.	Mass in left inguinal region	2 yrs.	Large scrotal hernia. External oblique, internal oblique, and transversalis very thin. External ring markedly enlarged. Some bulging external to deep epigastric theory	Modified Willys-Andrew	D
F. G.	43	W.	M.	Mass in left scrotum	6 mos.	Small projection of peritoneum entering left inguinal canal, high up. Scrotum ten times normal. Sac tense and distended with fluid, serosanguineous. Indirect inguinal hernia	Bassini and Jaboulay	I
S. K.	35	W.	M.	Mass in left inguinal region with pain	1 mo.	Indirect inguinal hernia	Bassini	C
E. L.	30	W.	F.	Pain in left groin	5 days	Indirect inguinal hernia with thickened, vascular, edematous sac	Willys-Andrew	C
A. R.	28	W.	M.	Mass in right inguinal region	5 yrs.	Congenital indirect inguinal hernia with incarcerated omentum. Testicle in inguinal canal	Bassini. Bottle neck	C
I. S.	46	W.	M.	Mass in left inguinal region. Pain in left inguinal region	40 yrs. 4 mos.	Large hernial sac from internal ring to scrotum. Contents, intestine and omentum. Muscular floor of canal deficient. No direct herniation	Willys-Andrew repair	D
D. S. (B)	41	W.	M.	Mass in left inguinal region	7 yrs.	Indirect inguinal hernia, incarcerated	Bassini repair	C
L. S. (B)	37	W.	M.	Mass in left inguinal region. Pain in left inguinal region	4–5 yrs. 2 weeks	Fair sized sac without contents, located at about external ring. Left indirect inguinal hernia	Bassini repair	C
A. W.	56	W.	M.	Mass in right inguinal region. Pain in right inguinal region	8 yrs. 2 mos.	Large indirect inguinal hernia, incarcerated. Sac 5 in. long, containing omentum and small loop of intestine. Hydrocele of testicle	Bassini-Jaboulay. Bottle-neck for hydrocele	I without cord hydrocele
M. M.	65	W.	M.	Mass in left inguinal region. (Operated upon 12 years ago on left side)	6 yrs.	Large indirect inguinal hernia. Sac 3½ in. long, containing loop of gut; not stranulated or incarcerated. Conjoined tendon lax	Bassini repair	C

incorporated in its walls and are stripped only with difficulty; longitudinal fibres of plain muscle and connective tissue form ridges on it, and the fundus is closely adherent to the tunica vaginalis of the testicle. The other type is a flat empty sac, whose walls and rounded fundus are clear to the eye with no preliminary dissection, which lies loose among the vessels, and which can be isolated with extreme ease. Its position is variable, and its walls contain no embryonic remnants. The former sac is certainly derived from a patent processus funicularis: the latter has begun as a traction pouch of parietal peritoneum, and is probably acquired; on a congenital defect as a basis.

In Table 1 the writer has attempted to classify 38 cases of a very large series in accordance with the ideas elaborated in this paper, placing them in the types illustrated in Figure 3. The operative procedure is mentioned, but not described. In the children and infants in many instances merely high ligation of the sac was deemed sufficient, especially in those cases where the neck of the sac was narrow because of the fact that the peritoneum and transversalis fascia had not stretched. The younger the patient the narrower was the neck of the sac. In older patients, particularly those who had a dilated sac at its neck with an attenuated internal ring, we must consider that there is a potential weak spot, and consequently additional supportive measures are used. By tying the muscle fibers of the conjoined tendon tightly enough, there is better union between it and the shelving portion of the inguinal ligament. As previously mentioned, a tight suture is followed by a fibrous tissue invasion (mesodermic) of the muscle with a consequent better union between it and its mesodermic counterpart, the inguinal ligament (Figs. 6, 7, 8).

SUMMARY

1. All hernias have a congenital basis.

2. The various locations and types may be explained from an embryological and anatomical standpoint.

3. The earlier the condition is recognized and treated, the less surgery is needed, simple ligation of the sac being enough.

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THE VALUE OF ENTEROSTOMY IN INTESTINAL SURGERY

AN IMPORTANT AID IN LOWERING THE MORTALITY FROM GENERALIZED PERITONITIS, ACUTE INTESTINAL OBSTRUCTION, PARALYTIC ILEUS, INTUSSUSCEPTION AND RESECTIONS OF THE INTESTINE*

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THE experience of many leading surgeons during the last ten or twelve years has concurred in establishing the value of enterostomy as a life-saving procedure in severe cases of acute peritonitis, acute intestinal obstruction, paralytic ileus and intussusception and as an additional step in association with intestinal resections. To the material already collected I should like to add my own experience in support of the evidence in justification of the operation of enterostomy under suitable indications.

To Victor Bonney[1] belongs the chief credit for calling the attention of the profession to jejunostomy as a life-saving measure in the treatment of acute intestinal obstruction and paralytic ileus. He advocated this operation particularly in the treatment of severely toxic cases, in which a more radical operation to relieve the obstruction might prove dangerous to life. With respect to the indications for jejunostomy and the results obtained, Bonney in 1916 wrote as follows:

> I hold strongly that all cases of paralytic intestinal obstruction (whether primary, or secondary to an organic obstruction or to peritonitis), when advanced to the stage of faecal, intestinal vomiting, should be treated by jejunostomy . . . By making an opening into the jejunum in a case of faecal or intestinal vomiting the source of the vomit is directly tapped and free drainage of the toxic material is established. No patient should be allowed to die with faecal vomiting if it is possible to perform this operation. Its effect in my cases has been remarkable; in all of them there has been immediate cessation of the vomiting, and all the patients have recovered.

Bonney's enthusiastic endorsement of enterostomy has been abundantly justified by the experiences of other workers. Judd and Rankin[2] in 1922 stated that, at the Mayo Clinic, ileostomy had proved advantageous following resection of the colon. The operation reduces distention from flatulence and makes convalescence smoother. Its advantages as a safety-valve and drain for the proximal intestine are obvious.

C. H. Mayo[3] (1922) states that in obstruction of the large bowel enterostomy, as a drainage procedure, may save life; that operation to remove the obstruction may be undertaken later; and that enterostomy is indicated in postoperative intestinal obstruction, if the condition has been present for more than twenty-four or thirty-six hours. If the obstruction follows a pelvic operation, ileostomy may afford marked relief; but, if there is high obstruction, jejunostomy should be performed.

Long[4] in 1917 described an operation for enterostomy by which the thermocautery is used to make the opening in the intestine. As the point of the cautery is withdrawn, the tube is introduced immediately so as to prevent escape of intestinal contents. According to Long, the use of the cautery has the following advantages: absence of bleeding, tendency of the opening to contract, sealing of the various coats of the intestines together, and freedom from eversion of the mucosa. In a second communication in 1926, he stated that he had often found enterostomy a life-saving procedure in cases of ileus; that it is indicated in almost every variety of obstruc-

* From the Department of Surgery, DeCourcy Clinic. Submitted for publication May 31, 1929.

tion, especially if done early and before extensive paresis has developed; and that the mechanical type of enterostomy yields most readily to simple enterostomy. In certain cases of peritonitis with "duplex obstruction" of the ileum and sigmoid and inhibition of peristalsis throughout a large portion of the intestines, Long found that enterostomy alone does not drain both the upper bowel and the colon. In such cases he advises a combination of entero-colostomy and enterostomy with a tube in the cecum.

Delore and Conrozier[5] in 1920 reported 22 cases of peritonitis with paralytic ileus, which were treated by enterostomy with 12 recoveries and 10 deaths. In each instance enterostomy was performed when the patient was in a serious condition and would probably have died without the operation. Enterostomy did not prove successful in any of the 7 cases of septic peritonitis of this series. Melchior[6] in the same year described 4 cases of peritonitis with ileus in which there was no improvement after operation for the primary condition but secondary enterostomy proved a life-saving measure by providing drainage and relieving localized intestinal paresis. When vomiting has reached the fecal odor stage in cases of intestinal obstruction, Summers[7] recommended that the small bowel be drained high up in the jejunum.

McKinnon[8] in 1921 advocated jejunostomy in acute intestinal obstruction and peritonitis and also in association with other abdominal operations to prevent postoperative ileus and vomiting. He termed this procedure "complemental jejunostomy."

Porter[9] in 1924 expressed the opinion that enterostomy should be utilized more frequently and that many deaths following operation for intestinal obstruction could be prevented by opening and draining the blocked bowel before removing the obstruction. This procedure frequently aids one in determining whether excision is necessary and lessens the danger of severe toxemia following relief of the obstruction. In cases of intestinal obstruction resulting from acute abdominal infection, Porter believes that the primary indication is for relief of the abdominal distention and drainage of the intestine. In such cases, enterostomy may be a lifesaving measure.

When the colon and lower ileum are resected, there is a tendency for gas to form so as to stretch the sutures and interfere with healing. In order to avoid this complication and assure physiologic rest, Horsley[10] (1924) performs enterostomy after resection of the colon. As the site of the opening into the intestine, he usually selects the lower ileum about 4 inches from the cecum, never closer than 4 or 5 inches to the line of resection. This procedure constitutes the last step in the resection. Horsley found that patients upon whom colectomy was performed made a much smoother convalescence when enterostomy was done. In about two-thirds of the cases the catheter can easily be removed at the end of a week or ten days and no fecal drainage follows.

According to Lee and Downs[11] (1924) jejunostomy should be performed alone or in combination with other procedures in all cases of acute mechanical intestinal obstruction of more than twenty-four hours' duration.

Nasaroff[12] (1925) believes that enterostomy in cases of paresis of the intestine and ileus shortly after a laparotomy may save life. He has found that the opening in the intestinal wall often closes without surgical aid, provided the drain is removed in twenty-four hours. Hübener[13] advocates secondary enterostomy for patients who show dangerous symptoms of intestinal paralysis after operations for peritonitis or ileus. He employed this treatment in 32 cases, frequently with good results, and never observed any ill effects. Pringle[14] advises jejunostomy, performed after the manner of Witzel's gastrostomy, for diffuse general suppurative peritonitis associated with appendicitis, tubal disease and other septic

conditions in the pelvis, particularly in cases in which the lowermost coils of the intestines are acutely inflamed and infection is already spreading upward.

Dixon, Burns and Giffin[15] of the Mayo Clinic, reported 6 cases of pernicious anemia in 1925 in which ileostomy was performed to relieve chronic intestinal toxemia. The patients all showed temporary improvement, maintained a good appetite and lost their icteroid tint. Glossitis recurred in only 1 case, when irrigation of the colon became difficult, and then disappeared a few days after the colon was flushed. The most striking feature was the disappearance of paresthesias in all but one case, in which this symptom was greatly improved. It would seem that ileostomy alters certain features of pernicious anemia and may sometimes be performed for this purpose.

Heyd[16] (1926) states that since 1912 he has been employing jejunostomy in preference to gastrostomy for an increasing number of indications. He considers jejunostomy the simplest way to make an alimentary fistula, because there is neither reflux, leakage nor cutaneous excoriation. When the tube is withdrawn, a secondary operation to close the opening is not required.

According to Heyd, the following are the conditions in which the most successful results may be expected from jejunostomy:

1. Disturbances characterized by obstruction at any point between the mouth and the stomach; for example, esophageal stenosis, carcinoma or cardiospasm.

2. Accidental or surgical injuries to the stomach in which attempts to close the defect are unsuccessful.

3. Widespread gastric ulceration, when complete rest for the stomach over a long period is required.

4. Gastrointestinal anastomoses, as a means of safe-guarding the sutural integrity.

5. Post operative ileus and diffuse spreading peritonitis.

6. Perforating gastroduodenal ulcer, when there is some doubt as to the firmness of the closure of the perforation.

7. As a preliminary to resection or excision of the larynx.

In postoperative ileus and diffuse spreading peritonitis Heyd prefers jejunostomy to ileostomy, because it provides better drainage. He does not believe that draining the most distended loop of gut somewhere near the terminal portion of the small intestine meets the disturbed physiologic and mechanical conditions. In intestinal obstruction, in which condition the chief problem is to prevent death from overwhelming toxemia and the relief of the obstruction is a secondary consideration, jejunostomy is the operation of choice. When ether anesthesia is contraindicated because of its paralyzing effect on intestinal motility, Heyd states that local anesthesia should be employed.

Rowlands[17] (1926), of Guy's Hospital, is convinced from his experience that enterostomy is "the simplest, safest and best method of treating the gravest forms of acute obstruction of the small intestine." Frequently this operation alone is sufficient to effect recovery without a secondary operation to remove the cause of obstruction; for example, when the relief of intestinal distention above an adhesion abolishes a kink. He describes a method of enterostomy, by which a valvular opening is made and a tube inserted and buried as in gastrostomy by the Witzel method. When vomiting has ceased and the bowels have acted, the tube is removed. Rarely is a secondary operation to close the fistula necessary. Rowlands has employed enterostomy in the treatment of certain cases of acute intestinal obstruction for fifteen years and has undoubtedly saved many lives thereby.

Brooks, Clinton and Ashley[18] (1926) state that enterostomy is indicated in severe cases of ruptured appendix with peritonitis, in intestinal obstruction, postoperative ileus, traumatic peritonitis, peritonitis due to ruptured viscus or perforated bowel, pneumococcic and streptococcic peritonitis, and in certain cases of anastomosis or resection of the stomach or bowel. Tuberculous peritonitis, however, is a

contraindication. Brooks and his confrères hold that there should be more primary enterostomies and that the operation should be performed earlier than is now the case.

From their statistical study of cases of acute intestinal obstruction treated with and without enterostomy, respectively, Van Beuren and Smith[19] in 1927 concluded that there is no satisfactory basis for comparison. Enterostomy has been used in only a small percentage of the total number of cases of acute ileus and apparently only as a last resort, when the condition was far advanced and the patient toxic. In such cases there is evidence that enterostomy has been effective in lowering mortality.

Macrae[20] (1927) believes that in later cases of intestinal obstruction, when septic peritonitis is present, the jejunum should be drained; that in mechanical obstruction, with or without resection, a catheter should be inserted into the bowel a few inches above the seat of trouble and the jejunum drained in addition, if the small bowel is implicated; that in all intussusceptions, early or late, the bowel should be drained immediately above the affected segment; that in all desperate cases of obstruction, whether due to mechanical factors or infection, both colostomy and jejunostomy may be necessary, according to the location of the obstruction and the extent of involvement of the small intestine; and that in late cases of appendicitis in which it may appear desirable to wait for abscess formation jejunostomy should first be performed.

In my experience enterostomy has proved a great help to intestinal surgery in both acute and chronic cases. In cases of peritonitis jejunostomy yielded very gratifying results. Patients with generalized peritonitis following gangrenous or suppurative appendicitis and pelvic inflammations, who were not expected to recover, changed overnight from extreme distress to general well-being and eventual recovery following this life-saving operation.

I perfo rmed jejunostomy for generalized peritonitis in 24 cases, 20 of them following suppurative appendicitis. In most instances, peritonitis was present at the time of the appendectomy; in several, it developed later. In 3 cases jejunostomy was performed at the time of the primary operation, because general peritonitis was present. One of these patients recovered. In the remaining 17 cases of the appendiceal series, jejunostomy was performed on the second, third or fourth day after operation, usually when symptoms of distention and rigidity were increasing and death appeared inevitable. Six of these patients recovered, including 2 of 4 patients with streptococcic peritonitis.

With reference to the 4 cases of the non-appendiceal series, 2 followed pelvic peritonitis; 1 ruptured gastric ulcer; and 1, a gangrenous cyst with twisted pedicle. Two of these patients recovered following jejunostomy.

Altogether 9 of the 24 patients (37½ per cent) recovered, although all cases seemed hopeless before jejunostomy was performed.

Enterostomy of the proximal loop following resection of the colon and sigmoid has lessened our mortality from this operation considerably. It has enabled us to perform a one-stage operation, whereas formerly we were obliged to operate in two stages. This is also true of resection of the small intestine for diverticula, intussusception, etc., when a great deal of distention is present, and of intestinal obstruction, when it is possible to relieve the obstruction at the primary operation.

In 6 cases of malignant disease of the large intestine in which resection of the gut and enterostomy of the proximal loop were performed as a one-stage operation, all of the patients recovered from the operation. In these cases it was found necessary to irrigate the tube frequently during the day, as it was likely to become clogged with fecal material. The irrigation opened the tube and allowed the gas to escape.

The technique I have adopted for per-

forming jejunostomy or ileostomy is modeled closely after the Witzel operation for gastrotomy. Following resection of the intestine, my practice has been to place an enterostomy tube in the proximal loop. In cases of intestinal obstruction, when distention is manifest, a tube is likewise inserted. Usually a catheter of No. 28 caliber is most suitable. It should be allowed to remain for seven or eight days, after which the fistula will close promptly, whether it be in the large or small intestine.

CONCLUSIONS

1. That enterostomy, performed under suitable circumstances, may be a life-saving operation has been established by the work of many authoritative surgeons.

2. The principal indications for enterostomy are generalized peritonitis, particularly the type of appendiceal origin; acute intestinal obstruction, when the condition has existed for more than twenty-four hours; postoperative ileus, when toxemia is imminent; and as a means of lowering the mortality and permitting a one-stage operation in resections of the colon or small intestine for carcinoma, diverticula of the small intestine or intussusception.

3. In a group of 20 jejunostomies performed at the DeCourcy Clinic for generalized peritonitis following suppurative appendicitis, all of them apparently hopeless cases, there were 7 recoveries. Four of these patients had streptococcic peritonitis, 2 of whom recovered. Of 4 patients with generalized peritonitis of non-appendiceal origin, 2 recovered following jejunostomy. Altogether, there were 9 recoveries in 24 apparently hopeless cases (37½ per cent) following jejunostomy.

4. Jejunostomy in association with resection of the large intestine for malignant disease was performed in 6 cases as a one-stage operation at the DeCourcy Clinic. All of these patients recovered from the operation.

5. Some procedure modeled after the Witzel operation for gastrotomy is generally employed for enterostomy. After the tube is removed, the opening usually heals promptly and rarely requires secondary closure.

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MEDICO-SURGICAL PROBLEMS OF GALL-BLADDER DISEASE*

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A REVIEW of the literature of the subject would seem to leave the impression that the problems of gall bladder disease are either medical or surgical and exceptionally a combined problem. This theory explains primarily the undue incidence of late cases for surgical treatment and the subsequent frequency of the unrelieved case after operation through abandonment by the internist and neglect of the surgeon in stressing the importance of medical treatment.

There is perhaps no disease in the annals of medicine having such a definite clinical entity that has so long beginnings and none so remote in its sequelae as the gall bladder complex. Surgeons in the nature of the case are concerned with the study of end-results with emphasis on the gall bladder, losing sight of much collateral pathology such as mild types of cholangitis, pericholecystitis, hepatitis and pancreatitis, explaining failures of cure in terms of surgical technique. W. J. Mayo says that which can be anticipated can usually be prevented and applying this rational to the gall bladder syndrome which according to our follow up records usually offers an average period of seven years for clinical study, we should be able more often to thwart the development of surgical conditions and this constitutes a challenge to the internist.

Progress of medicine must lie in tracing the cause of disease in an earlier stage of incipiency and in following treatment to a more remote period than has heretofore been practiced and the use of the word cure should have a more guarded application. Our follow-up records indicate recurrence of symptoms even after four or five years of apparent cure of surgical gall bladder disease. The problems of the gall bladder complex are primarily a better knowledge of the functions of the liver and secondarily, dietetic sins, obesity, focal infections and sequelae of sepsis, all such factors being more or less interactive and oftentimes associated with certain general consequent complications. This realm of preventive medicine offers a promising field for research and failure in this regard becomes a reason for the existence of the gall bladder surgery.

The liver, the first organ developed in fetal life and the great clearing house for food products, may be crudely compared to an internal combustion engine in which greatest efficiency is obtained only when the amount of intake of food products conforms to a certain inherent capacity for metabolism and any surplus may be a menace, and if man "digs his grave with his teeth" it is probably because of this surplus. The trite saying: "Fair, fat, forty and belching gas," very well protrays the back firing of the gasoline motor from a flooded carburetor in befouling the chambers and exhaust pipes of the engine.

Obviously obesity is wrought and maintained by an overtax of this metabolic function resulting in an increase of effete waste products which finally pave the way for the development of low-grade infections. On the other hand focal and general infections would seem at times to impair the metabolic capacity of the liver in the absence of obesity. Furthermore the intake of excess, especially of certain classes of foods that chiefly concern the liver such as carbohydrates and hydrocarbons, creates an additional burden

* Read by invitation at meeting of Fifth District Medical Society of Georgia, Atlanta, Dec. 7, 1927. Submitted for publication April 9, 1929.

and all of these factors finally revolve in a vicious circle especially in patients after middle life. The liver is perhaps the most long-suffering, overworked and abused organ in the body, especially among the sedentary well-to-do class, and the number of remote diseases indirectly wrought through imperfectly metabolized food products after middle life is legion.

We are beginning to hark back to the ancients who believed that the liver was the center of vitality, because disturbances of the metabolic functions of the liver in the light of present knowledge become predisposing causes not only of gall bladder disease but also certain toxic degenerative conditions such as hypertension, cardio-renal disease, etc. While within itself rarely the seat of fatal disease, modern science is now ready to say that man is as old as the dysfunction of his liver and time-honored convictions from long clinical observations are being corroborated by scientific investigations. Interest in the study of tests for dysfunction has had the effect of obscuring the importance of investigating predisposing causes of the gall bladder complex and present knowledge of the functions of the liver is sufficient to wage and intelligent campaign for prevention. We have had occasion to say not without reason to many candidates for operation that their gall bladder disease could have been prevented by beginning treatment a number of years previously for unburdening the liver function. This injunction has been substantiated by the fact that in a number of cases operated for other conditions in which the incidence of gallstones was noted that in having forewarned such patients not one has arrived at the necessity for surgery. While there is much to be learned as to the functions of the liver, research studies agree on many points. The liver maintains the level of blood sugar, making glucose from carbohydrates into glycogen which in muscular fatigue changes into lactic acid which in turn is in part reconverted into glycogen. The thyroid cells seem to energize the activity of the liver by facilitating oxidation. Bilirubin has its origin in the liver as well as from hemaglobin of the blood. Amino-acids, the end products of proteids, are changed into glucose and urea by the liver, which has an important bearing in the predisposing causes of renal disease. The liver also influences the production of fibrinogen which regulates the coagulability of the blood. Where there is no gall bladder, as in reindeer, gophers, and rats, bile is stronger and relaxes more easily the sphincter of Oddi. While the gall bladder normally contains concentrated bile it serves to relax this sphincter which remains relaxed after a cholecystectomy. Certain disturbances of the sympathetic nervous system from digestive overtax seem to stimulate spasm of the sphincter of Oddi. Pain in the back in the gall bladder complex is believed to be due to collateral pancreatic colic. There being such varying degrees of dysfunction of the liver latent icterus may be detected by the blood test for bilirubin.

According to Crile the liver produces one-third of the heat of the system and a reduction of the temperature of the liver as much as 1° impairs its function 10 per cent and for the same reason hepatic insufficiency lowers the body temperature. Water and alkalies mitigate the burden from dysfunction. Because the liver has a greater mineral content than any other organ Crile believes its function is more electrochemical than biochemical and for this reason the normal function of the brain and liver are interactive and any damage to liver cells produces a corresponding degree of damage to the whole system. Acute disturbances of the liver bring about a hypocapnic stage in which the liver cells inhibits the delivery of sugar and reduces the transportation of water, and for this reason forcing fluids becomes rational. Hepatic pressure as in jaundice is best relieved by fasting and fluids.

The methods of testing the liver function with certain dyes have gone a great

way toward recognizing certain disease conditions earlier than they were heretofore discovered and dysfunction has been demonstrated in the varying degrees of gall bladder disease, pregnancy, diabetes, epilepsy, thyrotoxicosis, syphilis, typhoid fever, cardiorenal disease, toxemias, essential hypertension, etc. So large an organ as the liver is more or less concerned in every type of general disease and while major pathology may be found in one, every organ becomes sooner or later more or less involved in the event of fatal issue. So in considering the predisposing causes of the gall bladder complex, the causes of these apparently remote diseases should receive careful investigation. According to C. H. Mayo for 100 years the per capita consumption of sugar has increased 113 lbs. Any excess over the normal production of glycogen goes to fat which may be later reconverted into glycogen for purposes of conbustion. Gall stones become an end result of disease but they do not measure the extent of disease. Cholesterol constitutes one-fourth of the blood fat and that which is not eliminated by the liver goes to the formation of gall stones; this becomes an important index in dietetic treatment.

Early and accurate diagnosis is important because a useless operation on the gall bladder is frequently more dangerous than that of a disease condition and the same is true of a gastroenterostomy. Ruef found 76 per cent positive tests of dysfunction of the liver in 130 operations and in the 24 per cent of negative tests pathological conditions were negligible.

In advanced conditions of disease, surgical trauma with a lowered temperature of viscera and toxicosis from chloroform and ether create dangers that can be avoided by rehabilitating the patient by a great intake of fluids with soda, calcium chloride in jaundice and adopting local anesthesia with or without nitrous oxide in operative procedure for a region that involves the most highly organized center of the sympathetic nervous system. For this reason the menace of using elevating bags under the back during operation has been referred to.

The medical phases of gall bladder disease have been indicated in a general way but the surgical problems create perhaps the most difficult responsibility known to surgery for the reason that elective operations can never be reduced to a certainty of indication and in any case of cholecystitis, however acute, there is always a lingering hope that the acuteness may pass off, in which certainty can at times be bought only by the price of operative hopelessness.

From 181 operations (mortality 6.6 per cent) on the gall bladder and bile ducts in our clinic we have selected 25 cholecystostomies, 25 cholecystectomies and 25 cases not operated on for a follow-up record at an average of four and one-half years since operation or examination. In these the average duration of previous symptoms was seven years. Of the non-operative class positively advised (19 per cent) to have operation not one reported improvement while one had died. Gall stones were present in 39 per cent of operative cases and the same percentage (63 per cent) of cures was obtained in the two types of operation. In interpreting follow-up reports generally, much depends on the mental attitude of the author. Cholecystectomy showed 31 per cent unimproved, 5 per cent having slight symptoms, while cholecystostomy gave 15 per cent unimproved and 21 per cent of slight symptoms.

The surgical problems offered for discussion may be briefly stated: How to rehabilitate the handicapped patient. When to operate and when not to operate. How long to temporize with an acute case. The problem of dealing with the atypical case. When to drain the gall bladder and when not to drain. How to minimize trauma in area of highly organized sympathetic nervous system. A pertinent question arises: Does opening up a highly organized lymphatic area in the presence

of marked infection constitute a greater menace than leaving a gall bladder to be followed by less dangerous sequelae?

Our follow-up reports giving the same percentage of clinical cures from the two types of operation lead us to believe that cholecystostomy, though handicapped by more advanced conditions of disease, gains such results by relieving chronic biliary stasis which therapeutic indication has not been sufficiently recognized. This back pressure after a cholecystectomy has been shown by Blalock to be sufficient in 38 per cent of cases to overcome the ligated cystic duct which constitutes an important signal to the surgeon.

SUMMARY

Theoretically the gall bladder complex should be the most preventable surgical disease in the abdomen. Excess of food products beyond a certain metabolic capacity of the liver as in the internal combustion engine is fraught with dysfunction and increase of obnoxious waste products. The liver is more or less concerned in every type of toxemia and sepsis, especially in the abdomen, and dysfunction is a mischief maker in the production of the ever-increasing frequency of degenerative types of disease after middle life. Obesity is a monument to an overworked liver. A greater degree of cooperation between internist and surgeon will lessen the number of candidates for surgical treatment, make those in need of it safer for surgery and finally will reduce the number of unrelieved cases after operation. A follow-up record at an average of four and one-half years shows the same number of clinical cures of cholecystostomy and cholecystectomy (63 per cent), with persistent symptoms were noted in 15 per cent in the former and 31 per cent of the latter, gall stones being present in 39 per cent of cases. The surgical problems are stated.

COMPARATIVE SAFETY & EFFECTIVENESS OF RELIEF MEASURES DURING LABOR*

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TO RELIEVE the suffering of the prospective mother during labor is the high endeavor of the obstetrician of the present day.

The public has clamored for a procedure which would afford a painless birth, and the extravagant claims of a few misguided enthusiasts have added fuel to these demands.

These claims have excited hopes destined to disappointment, since it is known that a painless birth through the birth canal is impossible.

So closely, however, has a painless birth been approached by the use of various procedures, that the parturient may now look forward to her confinement with the assurance that her suffering, when compared to that of her sister of a decade ago, will be infinitesimal.

To ascertain the comparative safety and effectiveness of these measures is the purpose of this report, and it would seem that the merits of any one of these procedures over the others should be reflected in an analysis of their maternal morbidity, fetal and maternal mortality, incidence of lacerations, anatomic end-results, and the extent to which they afford relief. The study embraces the following procedures: prophylactic version, twilight sleep, and prophylactic forceps.

The records of 435 consecutive births in the hospital are used for this purpose. The majority of the patients had been seen early in pregnancy and had received prenatal supervision; the others were referred because of some unusual condition complicating pregnancy or labor.

ROUTINE PREPARATION AND CARE OF PATIENT

On entrance into the hospital, the hair on the vulva, perineum, pubis and medial surfaces of the thighs was clipped and shaved; this was followed by a scrub with soap and water and a bichloride flushing. A bichloride towel was applied to the vulva and perineum, and was changed frequently throughout the duration of labor.

At the time of delivery a second washing with soap and water was given and a 3½ per cent solution of iodine was applied to the parts.

Rectal examinations were made routinely. Vaginal examinations were infrequent. In the majority of instances no vaginal examinations were made and no case had more than one.

After the third stage of labor was completed, the cervix was inspected for tears. These were painted with iodine and if extensive a trachelorrhaphy was done immediately.

MORBIDITY

Thirty-six versions were performed according to the technique of Potter, 30 in multiparae and 6 in primiparae. In 16 of the multiparae on whom versions were carried out it was desired only to avoid the pains of the second stage of labor. In none of these cases was there any disproportion; the heads were well engaged and delivery would eventually have terminated spontaneously. Three of the patients had flat pelves with a moderate degree of contraction; 5 were delivered of the second baby in twin births. The presentations were right occipitoposterior in 5 and left occipitoanterior in 3. The indications for the remaining 14 versions in multiparae were as follows: to correct presentations impossible of delivery; chin posterior (1), shoulder presentation (1),

* Presented as a thesis for admission at the Forty-first annual meeting of the American Association of Obstetricans, Gynecologists and Abdominal Surgeons, held in Toronto, Ont., September 10–12, 1928.

to avoid dissipation of the vital strength of the mother or child because of heart disease (2), thyroid disease (1), eclampsia (2), preeclampsia (1), accidental hemorrhage (1), placenta previa (1), and cord presentation (1). In three births the head failed to engage because of pendulous abdomen.

In the 6 primiparae, version was performed because of the following indications: transverse position (1), marginal placenta previa (2), eclampsia (1), the second baby in a twin pregnancy (1), and an occipitoposterior presentation which rotated into the hollow of the sacrum (1). Bag insertion preceded version in the first four instances.

It is generally conceded that version offers a safe method of delivery in labors complicated by certain types of abruptio placenta, placenta previa, presentation or prolapse of the cord and pendulous abdomen not due to an insuperable disproportion. Whether its use can be justified in the cases of the type included in the group of 16 multiparae first mentioned should be dependent on its safety to both mother and child.

It will be noted that version was not performed in primiparae as often as in multiparae. The explanation for this is that earlier experience with breech extraction in primiparae had impressed me with the frequent difficulty encountered in resuscitating babes born in this way. This difficulty was attributed to the prolonged interference with the fetal circulation which results from an endeavor to accomplish a slow expulsion through a pelvis of which the soft parts are not easily relaxed. The futility of attempting to overcome this bad feature by rapid extraction was manifested early, for this alternative is prone to result in the development of extended arms, nuchal hitch, and deep laceration of the perineum, complications which increase rather than decrease the risks of delivery. This reluctance to perform version in primiparae was furthered by the fact that the dangers to the babe seemed out of proportion to the relief obtained by the mother, since version could be only a second stage procedure and no relief could be expected during the first stage. I was not adversely influenced by the fear of tears, for I believed that in a properly performed version these would be no greater than in spontaneous delivery.

It was believed also, that version in multiparae offers a comparatively safe labor, for in these patients the soft tissues offer little resistance, and if the necessity arises for a rapid extraction, this could be accomplished. Then, too, it was expected that these individuals would gain much more relief from version than from the use of either the general anesthetic or the administration of scopolamine and morphine, since, if a spontaneous delivery is awaited in the former instance, relief is only available during contractions of the expulsive stage and in the latter, labor is usually so rapid that amnesia cannot be obtained without undue risk to the baby.

Despite the favorable statistics published, the possibility of infection attending this procedure could not be dispelled. Therefore, in the performance of prophylactic version a meticulous technique was scrupulously observed. The morbidity rate in multiparous versions was 18 per cent. A rise in temperature to 100°F. or more lasting for a period of two days or more between the second and fourteenth day was considered morbid. Two well-defined cases of puerperal endometritis developed, and convalescence was very much retarded. The reason for the rise in temperature in the other cases could not be determined.

This morbidity of the six primiparous versions was 80 per cent. This tremendously high figure is explained by the use bags and other manipulatory procedures antecedent to version in these complicated cases.

The morbidity rate of 18 per cent is relatively high when compared with that for spontaneous deliveries, prophylactic forceps, and breech deliveries in multiparae. The morbidity in spontaneous

labor was 3.7 per cent. Excluding one case of phlebitis following bag insertion, and two cases of postpartum hemorrhage, in which a rise in temperature to 100°F. occurred for three days without clinical evidence of infection, the morbidity for spontaneous delivery in multiparae was slightly over one per cent.

The morbidity for low forceps or prophylactic forceps deliveries was 4.8 per cent. In breech deliveries the morbidity was nil. This morbidity rate of version, 18 per cent, in multiparae remains high when compared with the morbidity of prophylactic forceps and spontaneous deliveries in primiparae; in the former the morbidity is 9 per cent and in the latter 5 per cent.

The morbidity of prophylactic version in multiparae was exceeded only by the rate of 25 per cent for breech deliveries and 33⅓ per cent for high forceps in primiparae. The reason for the high rate in high forceps deliveries in primiparae is similar to that expressed in explanation of the 80 per cent morbidity in version in primiparae; that is, factors other than the procedure itself may have entered into the production of fever, for in these high forceps deliveries there were 8 dry labors; the cervix was manually dilated 5 times; and bags were inserted in 2 cases of eclampsia and in 3 cases of preeclampsia.

The rate of 25 per cent for breech deliveries in primiparae may, perhaps, be explained by the frequency with which both feet were brought down and extraction begun as soon as the cervix was completely dilated, a procedure necessitating invasion of the uterine cavity.

The explanation for the high morbidity of prophylactic version in multiparae, inasmuch as no tears of the cervix or perineum occurred, lies, undoubtedly, in the transference of pathogenic organisms from the vulva and vagina into the uterus. The raw surface created here by the separation of the membranes preparatory to the rupture of the amniotic sac, affords a nidus for the growth and noxious activities of germ life.

It is worthy of note that of the four well-defined cases of puerperal infection in the whole series, two occurred in uncomplicated version, one in a bag insertion, and one in a cesarean section.

LACERATIONS

Efforts were made to prevent cervical and perineal tears in all cases. Pituitrin was not used unless complete dilatation of the cervix had occurred, and even then it was seldom employed. Testing the dilatability of the external os by separating the fingers was avoided in primiparae as well as in multiparae, as this is a pernicious habit and results in a slight tear which usually extends as labor progresses. In spontaneous deliveries the anesthetic was pushed to the surgical degree only when the brow could be reached through the perineum and recession of the head prevented; the further extension of the head was under control from then on, the patient being deeply under anesthesia and unable to call into play forceful contractions of the abdominal muscles. In version and forceps deliveries, ironing out of the perineum was practiced.

The frequency with which lacerations occurred in these various procedures was as follows:

In multiparae, cervical lacerations were equally rare in version, low forceps, and normal deliveries. Secondary repairs held well, as did primary trachelorrhaphies. Only once did a tear occur in a subsequent delivery following a primary trachelorrhaphy, and then a central tear appeared in the posterior lip instead of along the line of suture.

Perineal lacerations were more frequent. Breech deliveries produced no tears; version 3.1 per cent; spontaneous deliveries 9 per cent; and forceps 20 per cent. In secondary perineorrhaphies, primary repairs of second degree lacerations, and deep episiotomies, the tear invariably occurred along the line of scar.

In primiparae, 48 per cent perineal tears and 44 per cent cervical tears were found in 62 spontaneous deliveries. In

127 low forceps, perineal tears occurred in 64 per cent, and cervical tears in 42 per cent. In breech extraction, there were 64 per cent perineal tears, and the cervix was lacerated in 90 per cent. Version produced perineal tears in 100 per cent of cases, and cervical tears in 90 per cent.

The striking fact revealed by this analysis is that spontaneous labor has the advantage over the other two procedures, with version and extraction third.

Inasmuch as tears of the soft parts are prone to increase morbidity as is shown by the following figures, the full importance of the above comparison is obvious.

In spontaneous labors in multiparae with 9 per cent perineal tears, the morbidity is 1.7 per cent; in primiparae the percentage increased to 5 per cent as the percentage of perineal tears reached 48.5 per cent, and cervical tears 44 per cent. This would seem to indicate that tears, even though repaired immediately after labor, and showing no breakdown, subsequently, in themselves, increase morbidity.

The question naturally arises, is not morbidity more frequent in cervical repairs than when the cervix is left unrepaired? The figures show the morbidity for unrepaired cervices to be 12 per cent, and for repaired 1.7 per cent.

ANATOMIC END-RESULTS

The anatomic end-results in the total of 230 primiparae delivered spontaneously by version or forceps were as follows: Forceps and version in the delivery of twins accounted for a bilateral laceration of the cervix, retroversion, and a moderate degree of prolapse in 1 case. In 3 cases of delivery by high forceps, a relaxed vagina and cystocele developed in the first; cervical tear, prolapse, and retroversion in the second; and prolapse and retroversion in the third. Two normal cases of spontaneous labor without perineal tears showed vaginal relaxation and prolapse in one, and prolapse and bilateral cervical tear in the other. Three trachelorrhaphies failed to heal out of 57; 28 lacerated cervices were found six weeks postpartum. Of the 28 lacerated cervices, 25 were left unrepaired at the time of labor to determine whether or not they would heal spontaneously. They failed to do so.

The final results regarding the integrity of the birth canal depend, it would seem, not on whether spontaneous delivery occurred, or whether forceps were applied, or version was done, but on the following factors:

1. Avoidance of the use of pituitrin and the institution of operative measures to deliver the child while the cervix is not fully dilated. Such procedures not only tear the cervix but stretch and lacerate the connective tissue supports of the uterus and bladder.

2. Failure to employ episiotomy in cases in which undue stretching or tearing of the soft parts is imminent.

3. Failure to pull down the cervix into view in all cases, and to make repair if this is extensive.

4. Failure to appreciate the frequency with which lacerations are overlooked. Cervices tear without much loss of blood, and many pelvic floors are badly torn without tearing of the skin.

FETAL MORTALITY

Twenty fetal deaths occurred in the 435 deliveries, a mortality of 4.5 per cent. Of this number, 7 deaths were intrauterine; prolapse of the cord before the onset of labor accounted for 2 deaths; 1 occurred in a complete separation of a normally situated placenta at the eighth month; a tightly drawn true knot in the cord caused death in 1 case; 2 occurred at the fifth month, cause unknown. Dystocia caused 1 death; this occurred in an individual in whom a large fibroid was found completely obstructing the birth canal; she was seen for the first time two days after the onset of labor.

The remaining 13 deaths occurred as follows: 2 fetuses were delivered at the eighth month, both mothers were eclamptic, the first died seven hours following a spontaneous birth, the second could not be resuscitated following a forceps extrac-

tion; a spontaneous birth at eight and one-half months in a woman who died soon after delivery of influenza pneumonia, accounted for another; 5 stillborns were delivered, 3 of these followed difficult high forceps extraction; 1 a breech extraction, and 1 a prophylactic version; births of nonviable fetuses accounted for 5 deaths and 1 death occurred in a three-day old infant from a hemorrhage of the newborn.

If the 7 intrauterine deaths and 5 deaths in nonviable fetuses may be subtracted, the mortality would be 1.8 per cent.

It is worthy of note that there were no deaths in uncomplicated spontaneous or low forceps deliveries.

The death following prophylactic version could have been avoided by prophylactic forceps or spontaneous delivery. The same may be said for 2 deaths which occurred in a series of 24 versions not included in this report. All of these cases were ideal for the employment of version, that is, a multiparous birth canal, and the head engageable; yet complications resulted and three lives were lost.

The deaths in these cases occurred under the following circumstances: In the first case the babe was large: when version was completed the cord prolapsed and there was no pulsation; all efforts on the part of the mother to effect expulsion were unsuccessful; traction was made, and after some difficulty with the after-coming head, still-birth occurred. In the second case the cord was tightly stripped between the thighs, and the approximation of the gluteal folds interfered with its detection in utero. The cord was cut at the vulva and the babe inspired several times. The patient was exhorted to bear down, but the depth of anesthesia was such that no assistance was forthcoming. Traction was made with pressure on the fundus, and a nuchal hitch and extraction of the other arm resulted. The time necessary to overcome this complication was evidently sufficient to cause death of the babe. In the third case, a large baby appeared; there was no progress owing to the half-hearted efforts of the mother, and traction was equally inefficient. Pressure was made on the fundus at the time the umbilicus was in sight, and extention of the arms and fetal head resulted. Efforts to correct the complications exceeded the time limit, and fracture of the clavicle and stillbirth resulted.

MATERNAL MORTALITY

The maternal mortality in this series was 0.68 per cent. One patient died during the puerperium of bronchopneumonia following a cesarean section; one, of influenzal pneumonia at the time of delivery; one, following cesarean section for the hepatic type of toxemia.

SUMMARY

In brief, the findings in this series of 435 cases of labor reveal that:

1. Normal labor, when allowed to progress to the completion of the second stage and when unattended by signs of maternal exhaustion or interference with fetal circulation, was found to be the least hazardous means of delivery.
2. The maternal morbidity in spontaneous labor was less than in delivery by prophylactic forceps or version; lacerations of the birth canal were lessened in incidence and degree; and the maternal and fetal mortality was nil.
3. The procedure second to spontaneous labor in low fetal mortality and maternal morbidity was prophylactic or low forceps.
4. Prophylactic version yielded the highest fetal mortality and maternal morbidity.
5. None of these procedures gave a maternal mortality.

EFFECTIVENESS OF THESE PROCEDURES AS RELIEF MEASURES

Version provides a painless second and third stage of labor. Analgesia is obtained early, for the patient is deeply anesthetized just before the first step of the procedure, that is, ironing out of the perineum; as the knees emerge from the vagina, the administration of the anesthetic is stopped. The patient in a short time, if

chloroform is used, is able to bring into use her abdominal muscles without suffering pain, and the further expulsion of the fetus is accomplished. During the delivery of the shoulders and head, the patient is again anesthetized to the surgical degree. With the delivery of the fetus, the patient is given only enough anesthetic to make the delivery of the placenta a painless one.

It is obvious that in prophylactic version, no relief in the first stage is obtained.

This stage of labor, especially in posterior positions, causes suffering of the patient and its ill effects are many times greater than the second stage of labor where no anesthetic is used.

This failure of prophylactic version to give relief in the first stage could be overcome by the administration of either morphine alone or morphine and scopolamine up to near the point of complete dilatation of the cervix. But this idea when put into effect was soon found inadvisable for the combined action of these drugs plus the effect of the anesthetic, plus version and extraction caused deep asphyxiation of the fetus.

An altogether different picture presents where the Kronig method of administration of morphine and scopolamine is used. Relief is obtained here, not only in the second stage, but also in the first. A state of amnesia was the goal and not analgesia, for, when the latter was sought primarily, the dosage of morphine had to be repeated and this led to the following complications: asphyxiation of the fetus, prolongation of labor and operative measures to deliver the fetus. When one was contented with obtaining amnesia, it was found that over-dosage was unnecessary and consequently that the risks just mentioned were avoided. It was also observed that with this state of forgetfulness of the event, varying degrees of analgesia were obtained.

In these cases reported, scopolamine and morphine was used routinely, the only exceptions were in those instances where version or section was to be performed.

The results were as follows:

1. Complete amnesia, 75 per cent.
2. Partial amnesia, 23 per cent.
3. Failure, 2 per cent.

The partial amnesias were due to these factors:

1. Patients were seen late in labor. In these cases the rapidity in progress of labor was such that repeated dosage of scopolamine could not be given to effect complete amnesia without risking fetal asphyxia. (2) The amnesic state was present up to the expulsive stage in others; gas oxygen improperly given to control painful contractions, allowed islands of memory to occur.

Multiparae made up most of the group in whom the remembrance of some particular phase of labor was retained.

The failures of group three were due to an idiosyncrasy against these drugs.

No fetal or maternal deaths occurred.

Certain disadvantages of scopolamine and morphine administration presented:

1. Oligopnea in the newborn occurs in about 15 per cent of cases. It was not troublesome, however and babes responded readily to oxygen and intermittant compression of the chest wall.

2. The attendance of the obstetrician is necessary from the beginning of the administration until the birth of the child, if maximum effectiveness is desired.

3. Repeated dosage cannot be given according to rule. Administration will depend on the rapidity of progress of the first stage and the response of the patient to drugs.

Very occasionally errors in judgment occur regarding the interval that will elapse between the first dose and delivery. This interval should be at least four hours, and if miscalculated, one of two things will happen; either labor is stopped or the babe is born before the drugs have been eliminated. In the first instance no particular harm is done if the drugs are not repeated; in the second an oligopneic baby is born. This condition always responds well to treatment and the babe suffers no ill effects afterward. In order to avoid

these errors, one must be willing to spend the time necessary to determine (by frequent rectal examinations), that the patient is in labor and that progress is being made toward its termination. This information will determine when scopolamine should be repeated.

4. The second stage of labor may be prolonged. If, however, one starts giving the drug only when labor is well under way and discontinues it when cervical dilation is completed, prolongation of labor will not occur.

5. The necessity for instrumental delivery, usually low forceps, arises frequently. This interference is necessary because of the inability of the patient to use her abdominal muscles effectively during the expulsive stage. Failure to appreciate the need for forceps delivery may result in cerebral compression of the fetus.

CONCLUSIONS

1. On the basis of fetal mortality, maternal mobidity, the frequency of tears of the cervix and of the perineum, the safest method of delivery for the mother and child is a spontaneous labor.

2. Prophylactic forceps, if done at the outlet or when the presenting part is on the perineum, yielding in these instances no fetal mortality and only a slightly higher maternal morbidity than spontaneous labor, stands next in order of safety.

3. In prophylactic forceps, performed when the head is riding high there is a marked increase in morbidity. The risk to the baby is increased and there is an increase in the incidence and degree of tears of the cervix, perineum and fascial supports of the uterus, bladder, and rectum.

4. Prophylactic version carried, not only the highest morbidity and percentage of tears, but it yielded the only fetal mortalities in this series of cases.

5. The administration of morphine and scopolamine to obtain amnesia avoids the harmful effects of the mental and physical suffering of childbirth to a greater extent than does prophylactic version or prophylactic forceps. If the latter, however, supplements the administration of morphine and scopolamine, the benefits accruing from the drugs are enhanced and the percentage of partial amnesias are markedly diminished.

Note: In 200 consecutive cases delivered immediately following the compilation of these 435 deliveries, Gwathmey's rectal anesthesia combined with morphine and scopolamine was used as a relief measure, and a solution of acriflavine 5 per cent in 50 per cent alcohol and 10 per cent acetone was used as an antiseptic, in place of iodine. Three ounces of this solution were instilled in the vagina at the beginning of labor, and at the time of delivery it was applied to the vulva, perineum, thighs and lower abdomen. Excluding cases of pyelitis, engorged breasts and respiratory infections, a rather startling drop in morbidity rates occurred. The general morbidity was 1.8 per cent. There was no morbidity in the following deliveries; 50 spontaneous labors, 5 median forceps, 6 high forceps, 5 versions, 63 perineotomies, 26 lateral episiotomies, and 8 breech deliveries. In 114 low forceps, the morbidity was 1.7 per cent; 21 manual rotations with subsequent instrumental delivery 4.8 per cent; 10 Scanzoni 10 per cent; 8 bag insertions 12 per cent.

The combination of instillation of ether, quinine, and oil with scopolamine and morphine gave a much higher percentage of satisfactory results than the modified twilight sleep method. The relief of the multiparae which oftentimes failed to materialize with the modified twilight sleep was most gratifying. In these individuals one dose of morphine sulphate 16 grain, scopolamine $\frac{1}{150}$ grain immediately followed by rectal instillation effected satisfactory analgesia and amnesia for two or more hours. Repeated fractional doses of ether and oil were necessary in the majority of instances to prolong this state until after delivery.

Unless our results change as we continue our study along these lines, it would seem that by the use of these measures the risk of puerperal infection is diminished, and more relief during labor is afforded to a greater percentage of individuals.

USE OF THE CATHETER IN RETENTION*

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SUCH a familiar instrument as the catheter excites our interest only when we fail or face an accident in its customary use. We have become interested in our service at the Flower Hospital in the question of retention of urine, especially the postoperative type, as well as the various other forms of organic obstruction and the rôle of the catheter in this broad field. Almost every complication in the urinary tract, which arises after catheterization, is commonly attributed to the single individual factor of catheterization.

For example, we have seen a patient whose death followed nine days after a simple hysterectomy for fibroid as a result of fulminating septic pyelonephritis which had been attributed to the use of the catheter. In this case there was evidence of previous pathology and we believe that postoperative retention excited a latent infection and that such factors, rather than the catheter were, responsible for the complication. The use of a Dakin tube by a graduate nurse excited in another case a pyelitis which seriously complicated convalescence from an operation for carcinoma of the colon; a serious complication followed faulty technique.

To determine at the outset the frequency of catheterization in routine hospital work, we reviewed 300 cases admitted to the Flower Hospital between June 1 and October 1, 1928 (see Table 1). These were equally divided: 100 each among general surgical, gynecological and obstetrical cases. They were taken at random from among the records of that period both staff and private and the cases so selected were attended by a diversified group, thereby representing a more general survey as to the management of postoperative retention. There were 49 attending surgeons in the general surgical cases; 38 in gynecological and 36 in obstetrical cases. An analysis of this series shows that of the first group of 49 surgeons 26 per cent had their cases catheterized; of the second group of 38 surgeons in the gynecological service 39 per cent and of the third group of 36 in the obstetrical department 22 per cent ordered catheterization. It will be seen, therefore, that of the total of 123 attending surgeons over 25 per cent ordered catheterization for postoperative retention. Of the patients catheterized, 9, 7 and 9 in each division were catheterized only once and one surgical case was catheterized twenty-seven times.

Of the 300 cases chosen at random studied from the standpoint of the use of the catheter in postoperative retention, we found that the catheter was used in 15 surgical cases, 23 gynecological and 13

TABLE 1

100 Surgical Cases, 100 Gynecological Cases, 100 Obstetrical Cases — Picked at random; June 1–October 15, 1928.

Number times Catheterized	Surgical	Gynecological	Obstetrical
1	Female: 7 Male: 2	Female: 7	Female: 9
2	Male: 1	Female: 9	
3	Female: 1 Male: 1	2	1
4	Female: 2	3	1
5	.....	.....	1
6	.....	1	
7	.....	1	
11	.....	.....	1
27	Female: 1		
Total:	15	23	13
Number attending surgeons:	49	38	36
Surgeons catheterizing:	13	15	8
Percentage attending surgeons catheterizing:	26½	39½	22

* Read before the Eastern Homeopathic Medical Association, Camden, N. J., October, 1928.

TABLE II

SURGICAL CASES

	Number Cases	Voided	Catheterized	Percentage
Neurological:				
Gasserian radectomy	2	1	1	50
Subtotal resection, posterior root trigominal				
Abdominal:				
Cholecystectomy (6 q. appendect)	8	5	3	
Appendectomy	23	18	5	
Ileostomy	1	1	..	23⅓
Gastroenterostomy	1	1		
Exploratory laparotomy	1	1		
Hernia:				
Herniotomy	17	14	3	18
Fractures:				
Lacerations, amputations, extremities	15	14	1	7
Rectum & Anus:				
Male reproductive organs	13	11	2	15
Operation Benign & Malignant Growths	7	7		
Incision & Drainage:				
Carbuncle, abscess, infections	10	10		
Transfusions	2	2		
Total:	100	85	15	
GYNECOLOGICAL CASES				
Hysterectomy:				
Salpingectomy: oophorectomy	13	9	4	31
Salpingooophorectomy:				
Dilatation, curettage, cystic ovary, punctured appendectomy	31	24	7	23
Suspension uterus:				
Salpingooophorectomy appendectom	12	10	2	16⅔
Dilatation & Curettage:				
Tracheleorrhaphy, perineorrhaphy	35	28	7	20
Uterine suspension, cauterization				
Vaginal plastic	3	1	2	66⅔
Myomectomy	6	5	1	16⅔
Total:	100	77	23	

obstetrical cases. Only those cases are included in which the catheter was used as showing postoperative retention. In the 300 cases the incidence of retention is, therefore, 17 per cent. In analyzing these figures, we found that the incidence of postoperative retention was highest in the operations on pelvic and abdominal organs, varying from 18 per cent in hernia (total 17 cases) to 31 per cent in hysterectomy (total 13 cases). But we found, also, that in 2 cases of Gasserian ganglion resection one case required catheterization. In a total of 34 abdominal cases, including operation on the gall bladder, stomach, appendix, large and small intestine (exclusive of rectum or anus), 23.5 per cent of the patients were catheterized. In a group of 3 vaginal plastic operations, 2 required catheterization. We find, therefore, that the liability of postoperative retention of urine is pretty uniformly distributed in varying degrees in a diversified group of cases under the care of a diversified group of surgeons.

As to the time of catheterization, Table III shows that in the majority of the cases the interval was twelve hours after operation. But here again, except for a certain predominance, there is a wide range in the postoperative interval and a very irregular distribution. No relationship is indicated in this analysis of cases between the age of the patient and the liability or persistence of retention, since the youngest patient (seventeen years old) an appendectomy case, was catheterized four times and the oldest patient (fifty-three years old) a panhysterectomy case, also four times. It seems to us that in no field is there a greater disparity not only in age but in both surgical and anatomical liability of retention following operation.

The use of the catheter is a simple direct common procedure with a standard technique. In the male we believe a soft rubber catheter should be used of a small size (14–16) supplemented where necessary by the woven silk catheter of appropriate shape. In the male a metal catheter has no place in general hospital or general private practice and should be used only by an expert who seldom if ever employs it. Its use is prohibited in the Flower Hospital, except by the attending surgeon personally. In the female the Furniss catheter is ideal, since a small rigid catheter obviates the liability of contamination from inability on the part of the nurse to guide it accurately to the meatus without contact with the parts or bed linen. The danger of breaking the glass catheter in situ from a crack in sterilization, of which several instances are reported, has led us to banish all such instruments.

Table III

Operation	Case No.	M.	F.	Age	Number	Time Catheterized
Neurological:						
Gasserian radectomy	3961	..	x	53	1	(Before operation)
Abdominal:						
Cholecystectomy	3485	..	x	22	4	Once before operation; 12, 27, 37 hrs. after
Appendectomy						
Cholecystectomy	3840	..	x	29	1	11 hrs. after operation
Appendectomy						
Cholecystectomy	3531	..	x	27	1	Before operation
Appendectomy						
Appendectomy	3456	..	x	24	1	72 hrs. after operation
Appendectomy	3625	..	x	36	1	31 hrs. after operation
Appendectomy	3602	..	x	17	4	12, 22, 34, 46 hrs. after operation
Appendectomy	3810	..	x	45	1	12 hrs. after operation
Appendectomy	3946	x	..	39	1	12 hrs. after operation
Herniotomy:						
Herniotomy	3819	x	..	30	2	12, 28 hrs. after operation
Herniotomy	3680	x	..	34	3	17, 30, 54 hrs. after operation
Herniotomy	3817	..	x	30	1	4 hrs. after operation
Pelvis:						
Application of cast	3712	..	x	45	27	24 hrs. after, then at 12 and 24 hr. intervals
Fractured pelvis						
Rectum & Anus:						
Hemorrhoidectomy	3974	..	x	46	3	12, 18, 26 hrs. after operation
Excision fistula tract						
Hemorrhoidectomy	4054	x	..	45	1	14 hrs. after operation
Excision prolapsed rectum						
Gynecological:						
Hysterectomy, bilateral, salpingectomy	2175	..	..	32	2	8, 18 hrs. after operation
Hysterectomy, supravaginal, bilateral salpingectomy, removal left ovarian cyst	2636	..	..	36	2	12, 28 hrs. after operation
Hysterectomy, supravaginal, bilateral salpingiooophorectomy	3732	..	..	36	1	12 hrs. after operation
Hysterectomy, salpingo-oophorectomy right, perineorrhaphy, trachelorrhaph	2750	..	..	39	1	12 hrs. after operation
Panhysterectomy	3672	..	..	53	4	1, 72, 98, 122 hrs. after operation
Salpingooophorectomy, bilateral	3343	..	..	25	2	15, 34 hrs. after operation
Salpingooophorectomy right, appendect.	3329	..	..	19	1	18 hrs. after operation
Salpingectomy right, myomectomy, left cystic ovary punctured, appendectomy	3641	..	..	39	2	12, 17 hrs. after operation
Salpingectomy, bilaters; oophorectomy left, resection right ovary	2299	..	..	39	2	10, 29 hrs. after operation
Salpingectomy for left ectopic, oophorecomy appendectomy	3603	..	..	25	7	17, 34, 48, 60, 73, 85, 99 hrs. after operation
Oophorectomy left, partial right oophorectomy, appendectomy	3567	..	..	35	1	12 hrs. after operation
Partial resection right ovary	3084	..	..	28	3	12, 24, 36 hrs. after operation
Dilatation-curettage; cauterization cervix, right salpingoectomy	2509	..	..	31	1	19 hrs. after operation
Dilatation-curettage; caut. cervix	2213	..	..	26	2	7, 9, hrs. after operation

TABLE III (*Continued*)

Operation	Case No.	M.	F.	Age	Number	Times Catheterized
Dilatation-curettage; caut. cervix perineorrhaphy	3344	..	..	39	6	12, 24, 42, 66, 84, 92 hrs. after operation
Dilatation-curettage; perineorrhaphy trachelleoorrhaphy	3262	..	..	32	4	6, 18, 25, 36 hrs. after operation
Dilatation-curettage	3658	..	..	28	2	12, 16 hrs. after operation
Dilatation-curettage; perineorrhaphy ventral fixation; appendectomy	3759	..	..	52	1	9 hrs. after operation
Dilatation-curettage; ventral fixation appendectomy	3628	..	..	35	2	12, 24 hrs. after operation
Uterine suspension, Baldy Webster, trachelorrhaphy perineorrhaphy, cystocele, rectocele	3839	..	..	33	1	12 hrs. after operation
Uterine suspension, appendectomy	3577	..	..	37	3	18, 50, 78 hrs. after operation
Vaginal plastic	3327	..	..	29	2	18, 30 hrs. after operation
Vaginal plastic	3565	..	..	49	4	32, 40, 48, 56 hrs. after operation

We should look to our catheter. As a general rule hospitals are careless in regard to this instrument. The eye should be large and smooth and properly placed and the texture of smooth, soft rubber, not as of rough leather. Besides a proper instrument properly lubricated under adequate surgical protection, the technique of catheterization is equally important. The basis has been formulated by Gouley, who many years ago wrote: "deliberation and gentleness, the greatest steadiness and lightness of digits, the clearest conception of parts and the most precise concert of action of mind and eye and hand." Civiale urged that all instrumentation should be done *doucement et lentement*. We are sure that Omar was postulating the fundamental law in the use of the catheter when he wrote, "gently, brother, gently."

We believe that, when a catheter is employed in routine hospital practice, a urinary antiseptic should always be given as soon thereafter as possible, which should be continued for at least three to four days after catheterization ceases or, if necessary, supplemented by other treatment. We use urotropin in doses of 10 grains t.i.d. combined with sodium benzoate or ammonium chloride. A single catheterization does not require irrigation or instillation but repetition over more than two or three days calls for instillation once a day of either silver nitrate 1:2000 or acriflavine 1:2000, ½ oz. We cannot see the wisdom of irrigation, since there is nothing to wash away and the important object is emptying of the bladder and not its further distention. Where catheterization needs to be repeated over more than three days and more frequently than every eight to twelve hours, it is wiser to employ the retention catheter. When bladder function is restored, the catheter may be clamped for increasing intervals until the bladder resumes its tone. This simple maneuvre insures freedom of dysuria and repeated painful catheterization.

RETENTION

Retention of urine is a complicated problem depending on factors which interfere with the intricate mechanism of urination. Urination does not depend on direct nerve centers but on a reflex which has its origin in distention of the bladder, which we may arbitrarily define as having a capacity of about 400 c.c. A sense of fullness is transmitted via the sympathetic ganglia of the hypogastric plexus to the cord,

thence initiating a desire in the brain which originates the machinery of relaxation of the sphincter with contraction of the detrusor and in addition of the abdominal muscles. This sense of distention is probably conveyed by the trigonal muscle, as explained by Young, or may be a property of the whole mucous membrane. It is evident, therefore, that the act is a voluntary one so that physic factors, including the abolition of brain function occurring during anesthesia with the added factors of nervousness, shock, morphine and other psychic factors will profoundly influence it. A further illustration of its voluntary nature is the not infrequent occurrence of gradual and enormous overdistention of the bladder in patients dying slowly with gradual fading consciousness in whom at death enormous overdistention of the bladder may be found; and in overdistention occurring during coma. In this connection it is interesting to find that in a series of cases studied with reference to the capacity of the bladder in surgical cases, that in 372 cases catheterized 57.2 per cent showed about 400 c.c. capacity and in 1351 cases where urine was voided spontaneously 77.2 per cent showed an amount somewhat below 400 c.c. There is, however, a wide variation in the capacity of the bladder in health under normal physiological and nervous conditions and its capacity under the stimuli excited by operation both physical and mental.

Among factors which favor retention are paralysis of the bladder wall or atony produced either by injury to its nerve supply directly, as occurs in surgical or obstetrical cases, or indirectly by some lowering of tone in the nerve pathways, particularly in the functional capacity of the bladder itself. A second factor is the element of profound alteration in the circulation of the bladder induced by overdistention on the one hand and on the other by the presence of constant ineffectual efforts to void. Such general lack of tone is often found accompanying intestinal atony and retention is often found in cases with abdominal distention; indeed, postoperative retention of urine is often the cause of pain erroneously attributed to gas. Simple percussion and palpation of the bladder region should always be done if a patient complains of gas pain within a few hours of operation to determine bladder distention.

Of all the factors of retention, the one most frequently forgotten is the factor of residual urine. Sudden, acute retention of urine is almost as rare as sudden, acute suppression. In the presence of organic pathology, such as hypertrophy of the prostate, residual accumulation usually long antedates complete retention. Conversely, when acute retention occurs without any known previous pathology of the lower urinary tract, we find that the bladder does not regain its function at once but recovers after developing a phase of residual urine mechanism rather similar to that found in organic obstruction. In the former case this is, of course, operative until the cause is removed; in the latter it is only temporary until the elaborate function of urination is completely recovered. In the group of cases of reflex retention, residual urine may be suspected when a patient voids small quantities rather frequently after catheterization and these patients are prone to regain their normal frequency rather gradually. Such patients, when catheterization is repeated in from twelve to twenty-four hours after the first catheterization, show a residual urine varying from a few ounces to as much as a pint or more.

We are apt to forget that residual urine occurs in the female; it may occur as in the male from mechanical causes, such as cystocele, or even independently from reflex nerve causes or from persistent voluntary overdistention and faulty habits in urination. Whatever the explanation, it is surprising how frequently residual urine is found in the female when it is looked for.

In retention following general surgical

operations, even those remote from the bladder or urethra, distention of the bladder is essentially an atonic dilatation. Even when it is relieved by the catheter, such dilatation inevitably reduces the contractility of the bladder and, even when it regains its function, it is difficult to believe that it may suddenly resume it *in toto* so that the amount of residual urine present will pretty well measure the degree of impairment of function.

The causes of retention may be conveniently grouped into three groups:

Group I: Organic Obstructions. Fixed organic obstruction of the bladder or urethra.

In the male the most common causes are: (1) Stricture, especially of the membranous urethra, most commonly Neisserian in origin; rarely traumatic and very rarely but occasionally congenital; (2) diseases of the prostate, usually hypertrophy; (3) active inflammatory lesions of the prostate, particularly abscess; (4) carcinoma of the prostate; (5) carcinoma or tumor of the neck of the bladder; (6) calculus. In the female it should not be forgotten that stricture of the urethra occurs.

Group II: Neurogenic Retention. Disease of the central nervous system.

Pathological. (1) Neurosyphilis, which has a peculiar selective affinity (third sacral nerve) in its pathology of the cord on bladder function producing retention or paralytic incontinence; (2) multiple sclerosis; (3) general inflammatory and tumor lesions; (4) fractures of the skull and spine or pelvis; (5) early cord lesions of pernicious anemia of which retention may be one of the early predominating symptoms.

Functional. General reflex retention.

A diversified group of causes may operate to produce retention; among these are coma induced by alcohol or drugs, such as morphine, opium, etc.; certain infectious diseases all of which operate by disturbance in nerve function.

Group III: Retention in General Surgical and Obstetrical Cases. The incidence of retention of urine in general surgical and obstetrical patients has attracted a good deal of attention. Excluding previous pathology of the lower urinary tract, such retention is extremely difficult to explain. It occurs following operation in organs contiguous to or remote from the bladder or urethra and in all types of surgical cases, with sufficient frequency in obstetrical practice to make it a prominent factor. Whether it is entirely reflex as a sort of bladder fear and confusion in this function at a time when the central nervous system is preoccupied with impressions which obtund the bladder sense, or whether it depends on some unexplained toxic or mechanical factor, it is one of the most common forms of retention requiring the use of the catheter.

It is evident that retention caused by organic obstruction has nothing in common with the type of retention occurring in general surgical practice and yet even in the former the elements of spasm and of temporary congestion with edema are not so unlike when acute obstruction leads to confirmed and final retention, since such spasm is often present in the reflex type.

We may state in a general way retention is more frequent in women both in gynecological and surgical practice, and that it is likely to be more frequent in cases in which operation involves pelvic structures and to decrease the farther the site from the bladder or urethra. Postoperative retention is less frequent in the young; it seems to be definitely more frequent in older patients past the fourth and fifth decade. I can find no note as to its occurrence in any large series of tonsil or adenoid operations among children. But it seems to be, nevertheless, of very rare occurrence in children. It occurs in the adult following operations on the breast, thyroid or even other regions as remote as the extremities or skull.

Presumably it is favored by shock, by pain or the use of large doses of mor-

phine to control pain, nausea and vomiting; by the use of packing or plugs in pelvic operations which mechanically impinge on the tissue immediately adjoining the bladder or urethra; a psychoneurotic temperament or an hysterical attitude toward operation seems markedly to increase the liability of retention in themselves. Many of these factors are quite insufficient in explaining the irregular occurrence of retention. Bearing on the psychoneurotic aspect, Pedersen[18] uses the phrase "retention neurosis," especially secondary to postoperative catheterization, and reports the case of a girl aged seventeen who developed retention following simple appendectomy, for which she demanded catheterization over many months, although it was conclusively proved that she had no organic pathology and could be made to void. In such cases sexual perversity needs to be excluded. E. Sachs[4] calls attention to the volitional and purely reflex action of urination and gives the incidence of postoperative retention in his practice as 10.6 per cent. He stresses the importance of the psychic element, treatment of which has diminished the incidence of retention in his practice. There is no doubt that the psychic factor influencing volitional control is an important contributing factor in retention.

Voiding after operation may be quite natural or the voiding of small amounts. This usually indicates definite residual urine and, if there is any doubt as to the presence of residual urine, such a patient should be catheterized at the end of from twelve to fourteen hours to determine the amount. The estimate of the intake, as well as the output of fluid, will often determine the necessity for catheterization; after the patient is comfortable and voiding relatively small amounts infrequently without distress, there need be no alarm if at that time the intake is low or even below the normal for that patient. On the other hand, in the presence of bladder pain, even though the patient voids small amounts, it is evident that such a case demands careful attention. Simple catheterization may serve to empty the bladder and restore its function or may require a repetition; repetition of catheretization should be determined by the amount recovered and the amount voided, bearing in mind the intake.

The general attitude of most surgeons in the matter of retention is well represented by the most recent statement on this subject. Hughson[6] says:

> Percussion and palpation of the bladder is a much neglected form of examination; inability to empty the bladder after operation may cause serious developments. It should be dealt with promptly; some difference of opinion exists as to the length of time a patient should be allowed to go before measures are taken to give relief; eighteen hours is a safe average time; when there has been little fluid intake, the patient may be allowed to go longer; as large amounts of fluid may cause discomfort, catheterization may be done before eighteen hours; in general it may be said that *catheterization should be reserved as a last resort* except in certain gynecological conditions where bladder distension may cause breaking down of suture line. The development of a cystitis following catheterization in a patient whose surgical condition is not serious is indefensible; the only way to avoid it is *not* to catheterize. Another difficulty is the frequent necessity for catheterization once the measure has been employed.

Except for the splendid advice to examine for distended bladder, I do not agree with Hughson. There are two important facts bearing on the relationship of cystitis to the catheter. We are all familiar with a large group of patients on whom catheterization has been repeated and prolonged over long periods of time without the appearance of cystitis. Deaver reports the case of a female patient who was catheterized *at least four times daily for twenty-eight years;* retention without known cause occurred at the age of fourteen and continued until she came under his care at the age of forty-two; there is nothing to indicate serious infec-

tion from catheterization in all these years. In our own work we employ the indwelling catheter in the operation for prostatectomy and to us it seems very seldom to be a serious factor as a cause of cystitis. Cystoscopic studies have been made which seem to demonstrate the absence of mechanical or inflammatory lesions of the bladder after the use of the catheter. In a group of 730 cases of prostatic hypertrophy, Young reports that of 209 who had never used a catheter 150 showed definite evidence of infection (73 per cent), whereas in 229 cases who had used the catheter occasionally, 84 per cent showed infection; in 297 who had used the catheter frequently 90 per cent showed infection. He states that "residual urine is apt to be infected even tho the catheter is not used." Beck has shown that in a study of 259 gynecological cases presumably without urinary lesions, 130 had residual urine; in this group there were a total of 76 cases who showed definite infection; in a group of 120 who did not have residual urine only 16 had evidence of urinary infection and 104 showed sterile urine. It is perfectly evident that the accumulation of residual urine and the liability of postcatheter cystitis would be much greater in the first group, that is in the 76 patients with grossly infected urine, than in the 16 patients with minor infection. Taussig says: "The danger of infection lies less in the technique or frequency of catheterization than in the presence of urine stagnation in the bladder." Curtis says: "Observance of rigid asepsis seemingly exerts only moderate influence in diminishing the number of such infections." Mills, in his study of 2254 patients, stresses the importance of residual urine as a predisposing cause of cystitis.

We believe that it is the factor of residual urine or of overdistention that causes cystitis rather than catheterization *per se*. The catheter may injure the mucous membrane of the urethra and we agree with Osgood when he calls attention to the fact that such injury causes symptoms often described as "postoperative cystitis or bladder irritability." The hazard is in injury to the mucosa of the urethra rather than any injury to the bladder itself, such urethral injury resulting in rapidly advancing lymphatic infection of which the danger is not cystitis (which is relatively unimportant) but pyelitis and such cases are ushered in by chill and fever and, as we know, are comparatively rare in hospital practice. Such injury is usually the result of carelessness on the part of the nurse, particularly with a nervous, excitable patient, with spasm interfering with the introduction of the catheter or not uncommonly due to an imperfect catheter, which is rough, rigid or much too large. It is perhaps more frequent in the female but we have seen quite a goodly number of cases among male patients. We believe that in the retention of general surgical and obstetrical cases the use of the catheter is much less dangerous than overdistention.

In fact, we have a growing conviction that a good many of the cases of so-called "cystitis" following the use of the catheter are really cases in which retention itself favored infection. Such infection can have its origin in hematogenous infection. While the catheter may cause urethritis, it is very seldom responsible for cystitis. As Osgood says, such urethritis may involve the bladder but only indirectly and not as an immediate primary accident of catheterization. In fact, its intelligent use should do much to diminish urinary difficulties in postoperative care.

As a general rule, women have postoperative retention more frequently than men. Certain gynecological operations, which injure the tissues directly contiguous to the bladder or urethra, will necessarily cause injury at least of the nerve, if not of the blood supply, of the latter. We find, therefore, the incidence of retention highest in that group of cases. In the statistics (see Table IV) of Mills, it was found that in abdominal operations on the female

Table IV

COMPARISON OF CATHETERIZED DATA AT ST. LUKE'S AND JOHNS HOPKINS HOSPITALS (RALPH G. MILLS)

Groups of Operative Cases	ST. LUKES		JOHNS HOPKINS	
	Catheterized	Voided	Catheterized	Voided
1. Operations on rectum-anus	16 48.7 per cent	17	9 12.9 per cent	61
2. Operations on penis-scrotum	4 18 per cent	18	1 1.1 per cent	90
3. Operations on vagina & adjacent perineum (excluding #5).	4 18 per cent	18	30 29.7 per cent	71
4. Abdominal operations on female pelvic organs	8 22 per cent	28	145 45.2 per cent	176
5. Dilatation & Curettage Uterus	2 4 per cent	48	3 4.3 per cent	67
6. Operation for hernia, inguinal and femoral—both sexes.	9 16.4 per cent	46	7 3.8 per cent	175
7. Operations Kidney-Ureter	3 50 per cent	3	11 13.6 per cent	77
8. Abdominal operations (not *gynecological*)	23 17.5 per cent	108	55 13.1 per cent	365
9. Operations on chest, abdominal wall, back and hips	0	16	7 5.4 per cent	123
10. Operations on Arm	1 2.3 per cent	43	0	67
11. Operations leg and groin	0	91	3 1.5 per cent	197
12. Operations on head and neck (excluding #13–14)	1 1.1 per cent	92	7 1.5 per cent	468
13. Operations on the mastoid	4 13.8 per cent	25	1 2.6 per cent	38
Totals:	75 11.94 per cent	553	279 12.38 per cent	1975

pelvic organs over 45 per cent of patients required catheterization and in the series reported from St. Luke's Hospital 22 per cent; in operations on the vagina and adjacent perineum in the Johns Hopkins series almost 30 per cent and in the St. Luke's 18 per cent required catheterization. Taussig reports that in 31 radical cervical carcinoma operations 29 required catheterization and only two voided spontaneously, these being early cases without involvement of the parametria. In operations for hernia, both inguinal and femoral, including both sexes, the incidence of catheterization was only four per cent in the Johns Hopkins series and 16 per cent in the St. Luke's. Retention, however, may occur in operations remote from the urinary system, since in the Johns Hopkins series we find an incidence in group operations on the head and neck 1.5 per cent; on the mastoid 2.6 per cent; on the leg and groin 1.5 per cent. In the total of 2254 cases reported by Mills, including all types of operations grouped by regions, 279 required the use of the catheter and 1975 voided spontaneously. That is, 12.38 per cent had to be catheterized who had no previous known pathology of the lower urinary tract.

Taussig reports 405 postoperative cases covering almost every variety of gynecological operation; 94 required catheterization and 311 voided spontaneously. He reports a series of 157 puerperal cases of whom 6 required catheterization and 151 voided giving an incidence of catheterization of 3.8 per cent. In gynecological cases this gives an incidence of 23.2 per cent of women who required

catheterization who had no known previous pathology of the lower urinary tract.

In regard to spontaneous voiding, Taussig reports that 258 cases voided between one and sixteen hours postoperative and only 53 voided spontaneously between sixteen and twenty hours or more. Statistics seem to indicate generally that the possibility of spontaneous urination after operation occurs during the first fourteen hours and that, while in a small group of cases it may occur later, such cases are likely to require catheterization even after an interval of twenty hours.

In our 300 cases, we find an incidence of catheterization of 17 per cent. Mills reports 12.38 per cent in 2254 cases and Taussig 23.2 per cent in 405 cases. We may conclude that from the time of these reports up to this fall the figures remain substantially the same and establish definitely that no matter what the type of operation all patients entering the hospital stand over 10 per cent liability of developing retention requiring the use of the catheter. This liability of retention is directly proportionate to the proximity of the operation to the bladder. Many factors enter into the problem, such as psychic, nervous and mental stimuli, physical and surgical considerations and the peculiar reaction of all of these on bladder function.

In the whole problem it seems to me that we need above all to avoid the confusion which seems very general in regard to the rôle of the catheter and catheterization in postoperative retention. In view of the evident discomfort to the patient from retention and the actual serious menace of its complications, we have, as surgeons, a definite responsibility in regard to this puzzling problem of retention.

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PROSTATECTOMY*

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LOS ANGELES

I WISH to discuss some of the problems of prostatic obstruction. I have decided not to take up this subject in any natural sequence, but to concentrate here and there upon points which I thought might be of interest.

First of all as a background for this discussion, I will give briefly some statistics which I have gathered in connection with 243 consecutive cases on whom I have operated at the Hospital of the Good Samaritan in Los Angeles. Of these 243 cases 224 were operated for benign obstruction. Nineteen cases were operated on for malignancy. Of the 224 benign cases 209 were operated by Young's perineal prostatectomy, with a mortality rate of a little less than 1½ per cent.

This mortality rate for benign hypertrophy is one of the lowest that has yet been recorded for any similar series of cases. It seems to me, therefore, a useful thing to look back and to determine what procedures were used in producing this degree of curability.

However, I am not satisfied with these statistics. There are problems still for solution. Among these problems I would immediately discuss with you is the fact that the tendency has been to regard the disease of prostatis obstruction as one of unbearable urinary disturbance, or at most as a damaging kidney disease. Exactly 50 per cent of my cases have come for treatment because of complete urinary retention, and for that matter the rest of them have come because of various degrees of urinary discomfort. The average duration of illness has been five years.

The point which I wish to make, which has such a large bearing upon the curing of prostatic obstruction, is that while disturbances of urination are important it is of much greater importance to understand that prostatic obstruction is a disease of the most profound metabolic disturbance.

Surgery of the prostate has been directed by the whims of the bladder and not by an understanding that disturbances of metabolism of destruction nature to the prolongation of life are taking place. This derangement of metabolism not only affects renal function but the cardiovascular system is damaged in an attempt to restore renal function and the disturbance extends out to an exhaustion of various other systems of the body. It is my belief that there may be a certain degree of exhaustion of the adrenal and probably other glands of the chromaffin system.

In the past our decision to correct these metabolic disturbances have been dictated by the disturbances of the bladder. In the future it will be determined by earlier examination of these cases than our five-year period of illness would indicate in order that destructive lesions of other systems of the body may be avoided, and in order that the mortality rate or prostatectomy may be reduced.

Today we recognize the degree of kidney damage. We can determine the question of blood retention. I can foresee that the time will come when it will be possible to determine scientificially these exhaustions and derangements of other systems of the body. At present we must recognize that this does take place and that our so-called preliminary treatment must be carried on to a degree where the metabolism of the body and the capacity of its various organs of internal secretion have had time to return to a more or less normal state.

It is highly desirable that we should be proselytes among our profession and that we should teach that prostatic obstruction is never a thing of emergency of operation.

* Read before the Pacific Coast Surgical Association, Santa Barbara, Feb. 22, 1929.

In spite of our desire to remove this disease from the field of emergency surgery, it is probable that we will always have to deal with men who have, to varying degrees, been damaged by it. I will, therefore, review the manner in which I believe that cases of prostatic obstruction should be best treated previous to operation. For matters of discussion suppose we put into one group what we might term good risks, a second group of average risks, and a third group of bad risks. In what manner is preliminary treatment best carried out for these various groups? Let me say that all cases, with no exceptions, should have preliminary treatment for some period of time irrespective of how good his condition may seem to be. Let me say also that prostatectomy should never be done until that particular person has been cured and has become a well man, so far as relief of obstruction would ever be able to make him. We have then the best possible risk in that particular instance for doing a surgical procedure, the only feature of which is now the restoration of urinary function.

In all cases a preliminary vasotomy should be done before any type of drainage is carried out. This can be easily and without danger accomplished by injection of novocaine under the skin and without any attempt to isolate the vas one should immediately throw ligatures around the tissue containing the vas and divide between them. This procedure will practically abolish epididymitis, which may be a considerable drag upon the recovery of these patients and in my experience without vasotomy epididymitis occurs in at least 25 per cent of the cases, if not more.

To return to the method of preliminary treatment. Cases that I have designated as good risks are in general best treated by retention catheter. I do not believe that any irrigations should be carried out through the catheter as the bladder should be allowed to rest. This method of procedure is also the one that is the most satisfactory in the treatment of the vast majority of the middle group of cases. It is with the bad group that one's ingenuity is most brought into play. It has been long considered that the immediate withdrawal of large quantities of residual urine by catheterization is a dangerous thing. To avoid this, ingenious devices have been invented whose principle is that by attaching a tube to the retention catheter and elevating this tube until the pressure equals the intravesical pressure and by gradually lowering the tube gradual decompression of the bladder and kidneys can be brought about. This necessitates the fastening of a retention catheter into the urethra, a procedure which I believe to be a fairly dangerous one in the very ill old man. Because the absorption about the catheter alone is considerable. Not only this but if the urine is sterile the decompression is associated with immediate infection, in many instances bringing on an acute pyelonephritis at the same time decompression is being carried out. These cases are far better treated by catheterization providing that intermittent catheterization is done by a very competent person. Intermittent catheterizations should be carried on for a sufficient period of time to permit a safe suprapubic cystotomy. These patients should then be gotten up and in a great majority of instances allowed to go home to resume their regular life for a considerable period of time before prostatectomy is undertaken.

Studies of blood retention are very valuable in one way, and that is this, that any blood retention means a very high degree of kidney damage for even with quite low phthalein readings blood retention is not found. The compensatory powers of the body, loss of appetite, sweating, excretion by the bowel, are so great that when blood retention is present it may be depended upon that the patient is a very uncertain surgical risk. There may be big variations in tests of kidney excretions and yet the patient may be a very fair one for operation providing he

has been stabilized by drainage. Where tests of blood retention show high blood nitrogens one has no such leeway, and all such cases are to be regarded as fairly uncertain risks.

So far I have considered the problem of providing procedures for the excretion of urine and for the decrease of renal vesical pressure. Another problem that confronts us is that every prostatic is either infected or is going to be before he is cured. It would be highly desirable to avoid this infection providing we could do so and at the same time secure a similar degree of immunization. This has been attempted by vaccination, but vaccination does not produce the same result. A part, therefore, of our preliminary treatment, like Lady Mary Montague's inoculation of children with smallpox, consists of infecting our patients previous to operation. We carry on a rather curious procedure in this connection; that is to say, we know that these people are going to be infected and hope that they are. At the same time we are in the habit of giving them urinary antiseptics by mouth, perhaps with an idea of preventing an extension of the infection. I am not willing to break with this tradition.

Our problem next extends into a consideration of the cardiovascular system. It is not heart murmurs that I have in mind, nor yet arteriosclerosis. These are important studies but the point which I wish to stress is that, in my opinion, the cardiovascular control mechanism is in many instances badly damaged in its attempt to produce normal kidney efficiency and normal blood plasma. One thing has profoundly impressed me and that is the sudden collapse which may take place a short time following prostatectomy. This collapse, I believe to be due to a failure of the vaso motor mechanism, as I have proven to my satisfaction that such patients may be quickly restored by increasing the blood pressure by means of the introduction of salt solution into the vein. In this connection the prostatic cannot stand the same degree of hemorrhage that other cases stand with entire safety. They do not present the picture of hemorrhage. The pulse may be entirely normal and of good volume. It suddenly disappears. These accidents are not due to kidney damage, but are due to remote effects of prostatic obstruction on the cardiovascular mechanism. The nervous system is damaged in many ways by this disease. Who of you could stand being aroused several times every night as these people are? In addition to these disturbances due to loss of sleep, it is not uncommon to find marked despondency and even mental derangements. All of these disappear when proper urinary drainage is provided but there are evidences of the profound change which is taking place in these cases.

A word as to technical procedures. Let me immediately state that it is not a question of sentimental partisanship, but it is a question of statistics that suprapubic prostatectomy has never produced a curability that perineal prostatectomy produces. This being the case, it is interesting to determine the reason why. Among these reasons are dependent drainage, lack of disturbances of the peritoneum, lack of postoperative distention, but in addition to these well recognized surgical principles, there is another to which I would call particular attention. That is what I have termed localized immunity. Localized immunity is a curious thing. I am not sure that it is understood, but that it exists one cannot doubt. For example: Gonorrhea affects the urethra but does not affect the bladder, ureters, or kidneys. Tuberculosis affects the kidneys, ureters, and bladder, but does not affect the urethra, and it is just as true that the region through which perineal prostatectomy is done is relatively immune to infection as it is true that the region through which suprapubic prostatectomy is done is not immune. The higher curability, therefore, of perineal prostatectomy cannot be encroached upon by any type of development of technique

for suprapubic prostatectomy. The thing is a biological one and is inherent.

I will now discuss the matter of incontinence of urine following perineal prostatectomy. In 1914, I made an extensive investigation to determine this point. At that time, as you know, there were two types of perineal prostatectomy in vogue. One, the operation which is used today; namely, Young's perineal prostatectomy. The other, an operation known as median perineal prostatectomy, the latter a very poor inferior procedure. The results of my investigation on the mechanism of urination pointed out two points of interest so far as we are concerned in this discussion.

First: That one may with impunity destroy the internal vesical sphincter without incontinence. Second: That one may with impunity destroy the external sphincter muscle without incontinence but of course both could not be destroyed as was frequently the case in median perineal prostatectomy, and was not the case in Young's procedure in which the external sphincter muscle was retracted forward. Although Young had particularly stressed the portion of his operation which had to do with the preservation of the external sphincter muscle, the medical profession in general did not seem to be sufficiently impressed with the importance of this technical point. A few years ago Dr. E. G. Gereaghty and I simultaneously and unknown to one another described a type of perineal prostatectomy in which we avoided any injury to the external sphincter muscle by introducing a tractor directly through the entire extent of the urethra, and not through the region of the membranous urethra. None of these cases had the slightest degree of incontinence. This operation, however, presented considerable difficulty in bringing about good traction on the prostate and enucleation. It taught one lesson, however, and that was to introduce Young's tractor far back through the apex of the prostate and to carry out drainage through one of the lateral cavities rather than through the membranous urethra in the region of the external sphincter. This understanding eliminated entirely incontinence of urine from perineal prostatectomy.

In conclusion, I would like to state that it is these contemplations that will lead to a higher degree of curability of the prostate. It is these contemplations that will remove this disease from the realm of emergency surgery and place it in the position of a disease to be studied with thought from a metabolic standpoint.

SOME SURGICAL PROBLEMS IN JAUNDICED PATIENTS*

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WHILE the typical case of obstructive jaundice from stone in the common duct is not difficult to recognize and offers a brilliant result to surgical therapy, there are a considerable group of jaundiced patients of middle age and beyond in whom the suspicion of malignancy or other etiology for the jaundice is strong, while the possible presence of stone is hardly more than a hope. This group presents diagnostic and therapeutic problems of interest. This paper is a review of 35 cases from the surgical services of St. Luke's Hospital, all of whom were jaundiced and came to operation, and none of whom was a typical case of stone in the duct. Ages ranged from thirty-nine to seventy years.

By including only cases submitted to operation purely medical conditions have been eliminated except in so far as they were wrongly diagnosed. Hemolytic jaundice and obstructive jaundice from previous operative injury to the bile ducts have not been included as they are readily separated from the group which we are considering.

Of the 35 cases in about two-thirds the preoperative diagnosis as well as can be determined favored carcinoma. In a number stone was placed first among the possibilities although no case in which this was the probable diagnosis and verified at operation is included. A few other cases illustrating the difficulties of diagnosis in this group of patients complete the list.

The possibility of so-called silent stone in the hepatic or common duct is familiar to us all and the hope of such a finding in jaundiced patients furnishes a strong argument for exploration. Excluding those preoperatively diagnosed as having calculus, there are 25 patients of whom 2 were happily found at operation to have stone as the cause of their jaundice.

The first of these had had attacks of pain, apparently not severe. He had been jaundiced for three weeks. The second had been jaundiced for seven months; pain played a small part in the history. The first went on to recovery, the second, a woman of sixty-eight who had cancer of the bowel as well, died. In going over the records I have been impressed with how few such instances of calculus there are when malignancy is the probable diagnosis. Even 2 cases in 25 may, however, justify exploration.

The fear of submitting a case of so-called catarrhal jaundice to operation unnecessarily must come to the mind of the surgeon in studying a jaundiced patient. That this is not an undue risk, however, in the middle aged and elderly would appear from a study of this group.

There are 3 cases in whom catarrhal jaundice must be considered. In 2 of these cirrhosis of the liver was a positive finding. One had had icterus of two months and the other of one month duration with bile indexes of 200 and 100 respectively. In both the jaundice had cleared considerably before leaving the hospital after exploratory operation. Both were living and free of jaundice at last report one, four years, the other one year later. The third, a woman of fifty-nine, jaundiced for eleven days, with a bile index of 125, afebrile, no history of pain, came to operation with a diagnosis of probable carcinoma of the pancreas. At operation nothing was found to account for the jaundice. The common duct was drained.

* From the Surgical Services, St. Luke's Hospital, Read before the Section of Surgery, New York Academy of Medicine, March 1, 1929.

At the end of a year she was perfectly well. It seems probable that all 3 patients were suffering from catarrhal jaundice superimposed in the first 2 on cirrhosis.

McVickar and Fitts[8] from the Mayo Clinic state that in the presence of painless jaundice in the cancer age differentiation between malignancy and intrahepatic jaundice depends on the demonstration of bile in the intestine. They suggest as a working plan in doubtful cases carrying out duodenal drainage on each of three successive days. If no bile is obtained it will be safer to proceed with operation although in rare instances the case will prove to be one of intrahepatic jaundice.

Another patient, a man of fifty, was admitted five weeks after onset of what was thought might be catarrhal jaundice. On admission the icterus was slight, bile index 20. A bismuth series showed pyloric obstruction. At operation a mass at the pylorus was found adherent posteriorly. There were no stones. A gastroenterostomy and cholecystostomy were done. As the patient is well several years later the diagnosis, not wholly clear at the time, is undoubtedly ulcer. The case is cited as illustrating unnecessary delay in treatment because of the suspicion of catarrhal jaundice on superficial examination, and also as illustrating one of the rarer causes of icterus. It seems a wise rule in jaundice of doubtful origin in older patients to subject them to thorough study at once rather than procrastinate for several weeks hoping thereby to rule out catarrhal jaundice.

Beside the possibility of finding stone, there remains another possibility for a happy outcome when the source of obstruction is found at operation to be an enlarged hard pancreas, namely that the pancreatic tumor may prove to be inflammatory rather than neoplastic. Owing to the danger of biopsy on the pancreas, time is usually necessary to settle this question and in the great majority of cases the outcome sustains a verdict of malignancy. It is encouraging to find, however, that of the 14 cases in this series considered carcinoma of the pancreas 1 was alive and well four years later and another who died suddenly eighteen months after operation was working on the day of his death. The former of these 2 undoubtedly had pancreatitis and it is not unlikely that such was the case in the second.

Aside from these 2 patients there are 3 in whom the diagnosis of pancreatitis was considered most probable at the operation, and in whom the favorable outcome confirmed this diagnosis. In all 3 the pancreas was found enlarged. Jaundice had been present for from one week to six months. In only 1 had pain been a complaint. None had fever on admission to the hospital. In 1 case painless jaundice followed cholecystectomy and removal of a stone from the commonduct. Choledochoduodenostomy was the operation done. Cholecystostomy was done in the second and cholecystgastrostomy in the third. In no case was a diagnosis of chronic pancreatitis made preoperatively.

In 4 cases cirrhosis of the liver was the diagnosis at operation. Two of these have already been mentioned in discussing catarrhal jaundice. In both of them the preoperative diagnosis was malignancy. A third, jaundiced six weeks, and complaining of pain, at first severe, was thought to have stone in the common duct. At operation there was one stone in a slightly thickened gall bladder and cirrhosis of hobnail type. Autopsy showed no obstruction in the common duct. The fourth case is the only one in whom a preoperative diagnosis of cirrhosis was made. She was thought to have cholecystitis in addition. The jaundice was light, duration not stated. At operation cirrhosis was the only finding. She was unimproved. A fifth case was diagnosed as having carcinoma of the pancreas and cirrhosis, and in others fibrous or cirrhotic changes were noted. Enlargement of the liver was a common finding in the series.

Next to malignancy the commonest

preoperative diagnosis, made in 9 cases, was stone in the bile ducts. In looking over this group as a whole pain, at times severe, was, as would be expected, a feature of the histories. In the majority the jaundice was of rather short duration. Five of these patients turned out to have malignant disease, 1 each had pancreatitis, cirrhosis and hepatitis, with a question of malignancy in the later. The ninth was noted as having a dilated common duct from cause unknown. He recovered after drainage. In this case the jaundice was of one month's duration, hardly noticeable on admission and had come with an attach of epigastric pain. His gall bladder had been removed two months previously.

Hartman[1] in a study of 400 cases of jaundice found that carcinoma is the most common cause. In attempting to estimate the accuracy of preoperative diagnosis of malignancy one is handicapped by frequent lack of definite statement due after all to the fact that a considerable degree of uncertainty characterizes such cases. As well as can be estimated in 23 of the group malignancy was considered the most probable finding. Of this number 2 proved to have stone, 3 apparently had catarrhal jaundice and in 2, possibly 3 more, the outcome seemed to indicate pancreatitis, a rather comforting proportion of error. On the other hand there were 5 cases thought to have stone who had cancer.

Carcinoma of the pancreas was the commonest type of malignancy. The patients' ages averaged fifty-eight years. Jaundice had been present from five days to three months and was in most instances marked. Somewhat less than half the patients complained of pain, occasionally it had been severe. This is to be borne in mind in view of the common conception that obstruction from malignant disease is painless. The pancreas was usually described as enlarged or hard, sometimes as nodular. The gall bladder was found at operation to be enlarged or distended in over four-fifths of the cases but was palpable clinically in only about one-quarter so that inability to feel the gall bladder at examination does not weigh heavily against a diagnosis of malignancy. These findings are in accord with Courvoisier's Law. It is to be remembered, however, that a distended viscus is not necessarily palpable.

Malignancy of bile ducts, ampulla of Vater, and periampullary region supplied less than half as many cases as carcinoma of the pancreas. All complained of pain or distress. There was no great difference in gall-bladder findings from that of the pancreatic group. It is notable that of the cases diagnosed stone and found to be cancer 4 out of 5 were in this group. The 1 patient in the whole series who had a markedly febrile course had carcinoma of the ampulla of Vater, proved at autopsy. There were 2 cases diagnosed carcinoma of the liver. In 1 growth was found about the gall bladder and cystic duct in the other a large hard pancreas was noted in addition.

Judd and Parker[2] in a recent article on biliary intestinal anastomosis say: "Surgically, anastomosis is justifiable in all cases of carcinoma of the pancreas in which there is a reasonable chance that the patient may survive the operation. It prolongs the patients life and relieves him of much suffering."

In the series of patients classified as carcinoma of the pancreas anastomosis between the gall bladder and stomach or duodenum was done in 13 out of 14 cases. In the case in which it was not done flaccidity of the gall bladder was the reason. One in whom the gall bladder at operation was small and almost empty was not benefited as would be expected and left the hospital in poor condition. Two others were discharged improved but have not been heard from since. Three, discharged improved, lived for three months. One did very well for three months, gaining 28 pounds, then began to fail and died at the end of six months. Two patients lived a year. One patient died in fifteen months

without jaundice from general carcinomotosis. One patient at work and apparently in health died suddenly in eighteen months (already mentioned as possible pancreatitis). One is living at last report, four years after operation in apparent health. She has already been referred to as undoubtedly a case of pancreatitis.

Of 2 cases of malignant obstruction at the ampulla of Vater in which anastomosis was done both lived a year. One did well for two months, then pain returned. Jaundice recurred in eight months. The other when last examined at ten months was not jaundiced but in poor general condition and apparently had had no period of improvement aside from the relief of the icterus.

An anastomosis was done on 1 case of carcinoma of the bile ducts. He left unimproved with the comment that the growth extended too far up to allow the anastomosis to work. He was heard from three months later in another hospital, obviously without long to live.

The remaining 2 cases of biliary intestinal tract anastomosis were in patients classified as chronic pancreatitis. Both were in good health when last heard from in nine months and two years respectively.

Of 9 cases of anastomosis whose postoperative length of life is known, not including those thought to be pancreatitis the average duration is 8.7 months.

In going over the records I have not found any difference between those cases in which anastomosis was made to the stomach from those in which it was made to the duodenum.

In 2 patients who came to autopsy three months and a year respectively after cholecystgastrostomy it was found that the anastomosis had closed. It should be made of good size.

The question of mortality must naturally be considered in discussing therapy, and in a group of such poor risks it is high. Seven of the patients in this series died in hospital but this does not give the actual mortality, as the follow-up records, representing only survivors, was one source of the cases studied.

CONCLUSIONS

The fear of operating unnecessarily on a patient in the cancer age with possible catarrhal jaundice need not delay surgical intervention after careful study of the case.

In obstructive jaundice due to malignancy in this series pain, occasionally severe, was found in more than half the cases. It was relatively more common in duct than pancreatic carcinoma.

Silent stone in cases of jaundice thought to be due to malignant disease is disappointingly uncommon but is a reason for exploration.

Biliary intestinal anastomosis in malignant obstruction of the ducts is a palliative measure which seems worth while. An occasional case thought at operation to be carcinoma of the pancreas will turn out to be pancreatitis.

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MESENTERIC TUMORS*

REPORT OF CASE OF FIBROMYOMA

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MESENTERIC tumors are comparatively rare but occur with sufficient frequency to warrant a brief résumé of their salient characteristics.

The importance and value of a proper conception of the inherent dangers of these growths, and of an early diagnosis, cannot be overestimated.

Early surgical intervention will reveal smaller tumor formation, with less involvement of important structures, less metastasis, less liability of resection of intestines with its complications, the danger of hemorrhage, sepsis, and added shock. The avoidance of these sequelae means a much lowered mortality rate.

Symmers[1] quoted by Forman reports that in 5500 autopsies at Bellevue Hospital during the last ten years only 12 instances of lymphosarcoma were encountered. Bigelow and Forman[2] have collected from the literature about 100 cases of solid mesenteric tumors, and reported a case of lymphosarcoma in a boy of six. Ransohoff and Friedlander[3] report a case of fibrosarcoma with resection of bowel. Baldwin[4] removed a 25 lb. mesenteric fibroma and resected 6 feet of jejunum in a woman of twenty-four, with recovery. He also cites the cases of Jacoby and Kyle, in both of which resection of the bowel was necessary.

Judd and McVay[5] report the successful removal of a fibromyoma weighing 320 gm., with 26 cm. of small intestine. Spencer Wells[6] in 1885 successfully removed a fibromyoma, the size of a head, at the root of the mesentery, in a woman of forty. Shepherd[7] successfully removed an enormous mesenteric tumor and 8 feet of intestine. Harris and Herzog[8] reviewed some 56 cases, reporting one of their own. The classification was uncertain as they believed no microscopic examination was done.

Most of the earlier cases reported are lacking in histological findings; they represent the curiosities of mesenteric growths and cannot be utilized in arriving at any scientific data in the proper classification and comparative frequency of each type.

Szenes[9] reports the histological findings in 60 cases of mesenteric tumor: 18 fibroma (29 per cent), 11 sarcoma (18 per cent), 8 fibrosarcoma (13 per cent), 5 fibromyxoma (8 per cent), 3 lymphosarcoma, 3 lipoma (each 4 per cent), 2 each of myxolipoma, myxoma, endothelioma (3 per cent), 1 each of myxosarcoma, fibromyxosarcoma, osteoid sarcoma, fibrochondroma, carcinoma and fibromyoma (each 1½ per cent).

In this series, the benign growths represent 52 per cent, the malignant 48 per cent.

The mortality in the earlier reported cases ranged from 40 to 52 per cent; the rate increasing where resection of intestine was necessary. Later case reports are showing increased operative recoveries.

REPORT OF CASE

Mrs. G. M., aged thirty-seven, housewife, I para, was admitted to St. Vincent Hospital April 11, 1927.

Past History. Negative, patient had always been in good health.

Present History. Two years ago she commenced to complain of occasional headaches, and at various times, dysmenorrhea. Associated with these reflex pains she suffered with constant backache, of the ileosacral type. This pain was reflected down both thighs to the knees; often to right upper scapular region.

* Read before the Section of Pathology, Experimental Medicine and Bacteriology of the Academy of Medicine of Toledo and Lucas County, April 12, 1929.

Pain was severe in upright posture and intensified by various body movements. Pain was relieved by prone position with various belts and appliances designed to minimize spinal motion. The lumbar pain was dull, boring in character and persistent. The reflex pains were more sharp and acute and produced much suffering.

Examination. Vaginal and rectal examination revealed a large solid mass in the upper vault, posterior to fundus of uterus, slightly movable, and impinging on the posterior wall of pelvic colon. A tentative diagnosis of retroperitoneal growth was made, the nature of which was indeterminate.

Operation, April 12, 1927: A median abdominal incision disclosed a large retroperitoneal growth, the pelvic colon covering its anterior aspect.

The peritoneum of mesentery was incised on its outer aspect, the tumor was readily enucleated after tying the branches of the inferior mesenteric. One enlarged lymph node at the pelvic brim was also removed.

The mesenteric incision was closed with running catgut. Primary union occurred, convalescence was uninterrupted and the patient was discharged from the hospital in two weeks.

The day following operation the patient volunteered the information that all the subjective pains had ceased.

At present writing the patient is well; there has been no recurrence of growth or former symptoms.

Pathological Report (Dr. Thomas L. Ramsey). The growth appeared as a gland-like structure measuring 9 by 7 by 5 cm.; was smooth, lobulated, fairly well encapsulated by fibrous tissue and was of a grayish pink color. The cut surface showed lobulations separated by fibrous tissue bundles and had a structure not unlike that of a fibromyoma of the uterus except that the color was more yellow.

The growth showed distinct lobulation with bundles of fibrous and muscle tissue arranged very irregularly in a looser fibrillar structure which contained well-developed blood vessels and lymphatics. The fibrous tissue fibers were rather short and were arranged loosely around the muscle bundles. There was no evidence of malignancy seen in the growth.

A lymph node submitted with the specimen showed inflammatory hyperplasia with no evidence of malignancy.

Pathological Diagnosis. Encapsulated mesenteric fibro-myoma.

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THE BRIDGING OF OSSEOUS DEFECTS OF THE FOREHEAD

USING METAL MODELS AS GUIDES FOR THE SHAPING OF CARTILAGE TRANSPLANTS*

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REALIZING the need, in operating to fill defects of the forehead, of accurate metal patterns to guide us in the shaping of transplants, and having, after a fairly extensive review of the literature, been unable to find a method of preparing such patterns adaptable to our need we have devised the method which we are describing in this paper.

TECHNIQUE

Preparation of Models. The patient is placed upon the table in the dorsal position. The face is thinly coated with vaseline, the eyebrows being thoroughly greased. Small pieces of wet tissue paper are placed over each palpebral aperture and rubber tubes put in the nostrils for breathing. Plaster-of-Paris paste is prepared very thinly, and first poured into the depressions of the face. After that plaster paste, with all air bubbles carefully removed, is poured over the face in a thin sheet and allowed to set. This requires but a few minutes and causes surprisingly little discomfort to the patient. The impression is removed from the face, the tubes being carried with the plaster. A solution of soap in water is used to coat the impression which is then filled with thin plaster-of-Paris paste, again being very careful to remove all air bubbles. When the plaster has set up the two sections are separated by breaking the impression of the face away from the model with a knife.

Using dental wax which has been softened by heating, the defect is rebuilt on this model until the contour of the forehead has been restored. The wax impression is then cut into strips, the widths of which correspond as nearly as possible with the natural width of rib cartilage. The wax models are made thinner by trimming their under surfaces in the mid-portions, as the purpose of the graft is not to fill the defect, but to bridge it.

These wax strips are cast in aluminum, following the same procedure used by dentists in making gold inlays. In this part of the work the cooperation of a good dentist is most essential. Each strip is separately invested in a metal cup containing dental investment compound. After this compound has set it is heated with a blow torch until all the moisture has been removed. This burns out the wax, leaving the impression of the strip in the compound. Melted aluminum is forced into this mold, either by centrifugal force or an air-pressure machine. After the aluminum strips are removed from the investment compound they are polished, and are then ready for sterilization at the time of operation.

Technique of Operation. The operative technique described here is but a modification of procedures previously described.

Twelve hours before operation the eyebrows and hair over the frontal region are painstakingly shaved; the area cleansed by the soap and water, alcohol and ether method, and a sterile dressing applied.

Using 1 per cent novocaine solution for local analgesia the one-half thickness cartilage transplants are secured from the fifth, sixth, and seventh ribs through a curvilinear incision beginning near the midline and passing downward and out-

* Submitted for publication May 7, 1929.

ward over the cartilages mentioned. More than a sufficient amount of cartilage is secured and placed in normal saline solution. An assistant closes the chest wound and the patient is anesthetized with ether.

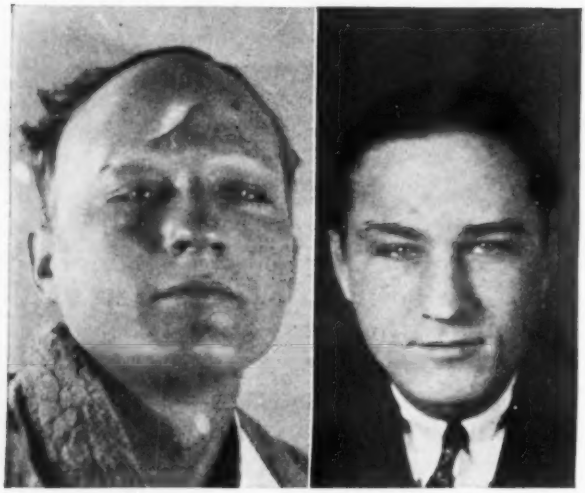

Fig. 1. Fig. 2.

Fig. 1. Mr. E. T. (Kicked by horse sixteen years previously.) Old fracture of skull with extensive depression in frontal bone and loss of entire supra-orbital ridge.

Fig. 2. Same case as Figure 1. Three months after cranioplasty.

Using the previously prepared aluminum models as guides the surgeon fashions the grafts while the patient is being anesthetized, bearing in mind that the uncut surface is to be placed downward, because of the tendency of the cartilage to curl with the convexity toward the cut surface.

The incision over the hiatus must vary with the case at hand, any previous scar is removed when possible, and the natural lines of cleavage observed inasmuch as is compatible with a free exposure of the hiatus. A curvilinear incision is satisfactory for this purpose, the edges being beveled to minimize scarring.

The incision extends through skin, scar tissue, aponeurosis and epicranium. The epicranium is stripped back from the bone and the hiatus exposed. With a sharp chisel the edges of the bone are pared around the defect for a distance of ¼ inch. The grafts are then tried in place and any other necessary trimming of the cartilage is done. With the final placing of the grafts the epicranium is brought over the edges of the cartilage. The grafts are secured in place by passing one end of a catgut stitch through the epicranium and tying it. It is then carried to the epicranium of the other side of the gap and then backward and forward over the transplant in a zigzag fashion until the area is covered.

Fig. 3. Fig. 4.

Fig. 3. Plaster model of face showing defect in forehead.

Fig. 4. Metal patterns filling defect on plaster model.

The wound is closed in layers, interrupted stitches of horsehair being used

for the skin. A tight compress is applied and readjusted on the third day. Stitches are removed on the fifth day. The compress is worn three weeks.

DISCUSSION

From a fairly extensive review of the literature it seems remarkable that so few instances of autogenous grafts for the bridging of defects of the skull have been recorded. In plastic procedures upon the forehead a more accurate cosmetic result must be obtained than in other areas of the skull; and the frontal bosses and supraorbital ridges with their intervening depressions render our task a more intricate one.

Of the several types of transplants which have been utilized for this purpose, mention is made in the literature chiefly of grafts from the rib cartilage, and bone grafts from the tibia, rib and outer table of the skull. The one-half to two-thirds thickness chondral transplant seems to have met with the most universal approval. The advantages claimed by it's advocates are: (1) By leaving the posterior portion of the cartilage intact most rapid regeneration of the rib is provided for; (2) cartilage is more easily patterned and molded to fit a given contour than bone; (3) it heals rapidly, and (4) although thin strips of cartilage do tend to become absorbed, the graft one-half to two-thirds the thickness of the rib is not absorbed but becomes firmly embedded in fibrous tissue.

SUMMARY

1. In plastic procedures on the forehead accurate cosmetic results are more essential than in other areas of the skull.

2. Correct restoration of contour is more difficult in the frontal than in the parietal and occipital regions because of the frontal bosses and supraorbital ridges with their intervening depressions.

3. The autogenous cartilage transplant is, to our minds, the material of choice for bridging defects in the frontal region.

4. A method of preparing models for the shaping of cartilage grafts is described.

5. The operative technique described is a modification of previously described procedures.

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* We wish to thank Nelson's Research Bureau for assisting us in this bibliography.

PAINFUL FEET*

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SINCE the average person thinks that orthopedic means deformity and that pain in the feet signifies deformity, he seeks the advise of an orthopedic surgeon for the relief of his condition. It behooves us, therefore, to give this subject more careful consideration than we have been accustomed to give it in the past.

At the New Jersey Orthopaedic Dispensary we have been studying foot conditions for a number of years and have been forced to draw very different conclusions than those commonly accepted as true. It is our opinion that pain in the feet, whether it be located in the bursae, tendons or joints, is a symptom of disease elsewhere in the body and that deformity of the feet is due to spasm of the muscles in their effort to protect the foot from pain.

The most common cause of painful feet is arthritis, most frequently affecting the joints, then the bursae and then the tendons. The feet are affected more frequently than other parts of the body because man, being a biped, is forced to carry his weight on these organs and they are therefore much more subject to traumatism than are the other joints. Pain manifests itself earlier in the joints of the feet than in other joints because in normal walking all parts of the foot must move through its complete arc of motion, while the other organs of locomotion only move through their complete arc in exceptional instances. Pain in the feet is, in our opinion, primarily an indication of overwork, and secondarily, it is an indication of worry due to the inability of the patient to carry on.

If the patients complaining of pain in the feet are carefully examined it will be found that many of them have some pain and limitation of motion in other joints of the body as is clearly shown in the study of the statistics of 1000 consecutive cases, which forms the basis of this paper. These statistics will be given later.

The feet become everted because of the contraction of the peronei muscles, just as the knee becomes contracted when that joint is affected by disease. The toes are drawn up in hammertoe position in order to keep the joints quiet and to remove the metatarso-phalangeal joints from pressure on the ground. These deformities cause an abnormal amount of friction on the ball of the foot and on the middle joints of the toes, causing corns to develop on the toe joints and callosities to develop on the soles of the feet. The corns and callosities are not due wholly to friction but are partially due to heat in the joints themselves.

The bursa most frequently affected is situated below the os calcis, second in frequency is the one under the great toe joint and third, the one over the base of the fifth metatarsal. Other bursae are affected at times. These have been fully described in Roberts' recent article on the bursae of the feet. Tenosynovitis sometimes affects the tendons of the feet but this condition is usually found in bad cases of arthritis where all the muscles and fascia of the foot are held in extreme spasm.

Let us now consider the foot itself. There are no two feet exactly alike, not even those of one person. Some people have normally high arches, others have normally very low arches and the rest range between these two extremes. It is our opinion that a foot is normal for a given individual regardless of the height of the arch, providing the alignment of the foot and leg is proper. In other words

* Read before the Section of Orthopedic Surgery, N. Y. Academy of Medicine, May 17, 1929.

the os calcis must be squarely placed below the leg, any deviation to one side or the other constituting deformity. Pain is found quite as frequently in the feet of patients with high arches as it is in those with low arches. The prognosis of this condition is always good providing one can control the patient. Women are more frequently subject to pain in the feet than men, but girls are no more frequently affected than boys. We believe that women's shoes may have something to do with their troubles, but the principal reason for their pain is the nature of their work. They are usually on their feet much more than men and they are much more prone to eat when they are tired. We lay great stress on tiredness because we believe a tired stomach will not properly digest food and improperly digested food causes autointoxication, which is the most important cause, in our opinion, of arthritis. All animals rest before eating especially in their wild state. Horses, if fed when tired will become foundered and consequently great care is exercised in feeding them. Surely, man is quite as important economically as the lower animals.

Fig. 1.

Fig. 2.

Figs. 1 and 2. Absolutely flat painless feet.

Tuberculosis is usually nonarticular and consequently is fairly easily distinguished from any other joint condition. Spasm, too, is a distinct feature in this condition; swelling is rather typical. Roentgenography usually shows some destruction of the joints.

Obliterating endarteritis in its early stages is always difficult to differentiate from other forms of disease. The arteries of the feet should always be carefully palpated to determine their size. The nationality of the patient, the severity of the pain, and the color of the toes, will usually be sufficient to make a diagnosis of this condition.

Fig. 3.

Fig. 4.

Figs. 3 and 4. Painful feet in patients with well-formed arches.

Kohler's disease and epiphysitis are easily differentiated by roentgen ray, and other conditions, such as diabetes, gangrene and Renaud's disease occur very infrequently but nevertheless should be looked for.

In the statistics which follow we have stated that the pain occurs in other joints, but in many instances the bursae were affected rather than the joints.

Of the 1000 patients studied in this report 299 were males and 701 were females; 222 or 22 per cent of these patients gave a personal history of having pain in other joints, either persistently or at times, 128 complained of pain in shoulder, 53 of pain in the elbow and 72 of pain in the hand.

On examining these patients we found that 766 patients had pain in the joints of their feet, 592 or 59 per cent of the total number had pains in other joints besides their feet, 336 patients had pain in their knees, 140 had pain in hips, 197 had pain in spine, 263 had pain in shoulder, 334 had pain in elbow and 460

had pain in hand or wrist. Fourteen patients had trouble with tonsils, 35 with teeth and 340 had some gastro-intestinal disorder, 83 patients had some limitation of dorsiflexion of their feet, 127 patients had weak feet. There were 8 cases of pigeon toes or internal torsion of the legs, 2 patients had scurvy, 13 patients had some rachitic deformity, 3 patients had claw feet and 12 had hallux valgus. The remaining patients suffered from a variety of conditions affecting the feet.

It would be impossible to discuss fully in this short paper the treatment of all these conditions, but probably a few words about the treatment of arthritis which is the most common of these ailments would not be out of place.

TREATMENT

Arches, arched shoes, strapping and padding, because of their splinting effect on the joints of the feet may relieve the the pain. If the cause has been removed beforehand, these forms of treatment are good, but if the cause has not been removed arches and special shoes will in many instances enable the patient to do more walking while the disease gradually progresses, affecting other parts of the body, principally the heart and blood vessels. We believe that many cases of heart disease and most severe cases of arthritis could be avoided by the proper treatment of painful feet. *Rest* is of primary importance in the cure of this condition. Proper strapping will temporarily relieve the pain and can be removed when the disease is cured. Thorough catharsis, preferably by use of sodium sulphate, in teaspoon doses before breakfast, will clear out the intestinal tract. The patient must be warned to rest before meals and not to eat if he is mentally upset or excited.

CONCLUSIONS

1. Pain in the feet is usually a symptom of arthritis.

2. Patients suffering from pain in their feet should be given a careful physical examination.

3. Patients suffering from pain in their feet should not be referred to instrument-makers or shoemakers for treatment.

4. Most patients suffering from painful feet have pain in other joints of their body.

5. Arches and special shoes are contraindicated because they relieve pain without relieving the cause.

DISCUSSION

Dr. Armitage Whitman: Dr. Humphries has made it perfectly plain that we should not allow ourselves to be regarded as foot specialists. We should always make every effort to have the distinction between the orthopedic surgeon and the foot specialist universally understood. I cannot quite agree with all of his conclusions, but am in sympathy with his claim that every one who comes to a doctor's office should be subjected to a thorough examination to get at the root of the trouble. We should treat the patients as patients, and not as cases representing what we choose to call the presenting symptoms. We are too much inclined to accept the patient's own diagnosis. If we could treat these patients from the general social standpoint, as Dr. Humphries has suggested, it would be very desirable. I have never understood why an aching foot is a subject of ridicule and an aching finger one of extreme concern. Any one with a felon can go to a hospital and be treated by a surgeon-in-chief; whereas if the foot hurts him and incapacitates him as a wage worker he is the subject of ridicule. I think the foot is more important to the average individual than the hand. To the person who has to be on his feet it is almost the most important member he has. When I was in the hospital not so very long ago, a patient with all the tendons of the wrist severed would be treated by the house surgeon in the accident room, whereas any one with a haemorrhoid would be taken into the hospital and operated on with full aseptic precautions. Dr. Humphries has opened a wide door to a very much needed reform.

Dr. E. D. Oppenheimer: I agree absolutely that the sensitiveness of the foot is mainly an expression of the general condition. When

the foot is locally sensitive it does not mean that one tissue alone is affected, the whole foot is involved. It is not the foot alone that is susceptible; if the patient walked on his hands, he would have his reaction in his hands. This reaction of metablastic tissue is present in all cases of arthritis. Whatever infection or lesion is present we cannot demonstrate to our own satisfaction.

Personally I feel when I give a patient plates I give them what mechanical help I can; but I would not stop there, the patients are sick and need general help. Next to the foot, the back is the most common source of complaint. We speak of the feet being weak, of the back being weak. It may be that these are reflexes due to some local sensitiveness, may be a low-grade infection.

Dr. W. H. Irish: I was much interested in Dr. Humphries' statement but felt that it was like putting the cart before the horse. In many cases the pathology does come first and then the resulting deformity; but of course these feet are, no doubt, arthritic to start with. The vast majority, however, start off with a deformity in a very important structure, the foot, a weight-bearing organ. If there is a deformity it is subject to continual trauma, and naturally increasing deformity. This joint or series of joints, is exposed to continual trauma, is continually open to attacks of infection or toxic elements, and naturally makes a fertile field where arthritis will start.

As regards the complication of the knee; I have seen many cases of knee joint pain and irritation in persons who have been treated in various hospitals for arthritis of the knee, and yet we fail to find in these joints any changes showing in the roentgen ray proportionate to their symptoms. On examining the patient's feet, we find them pronated, with marked deformity which is increased on standing. The mechanical basis of this is easy to understand. With the deformity of the foot there is improper distribution of body weight, torsion of the knee, and irritation of the joint structures, chiefly the synovial membrane. Not one of these cases have I seen with proper support to the foot. It is the same with the hip and the back. If we have a disturbed foundation there is irregular stress and strain brought throughout the whole structure. Many of these cases are started in childhood. The hereditary type of weak foot if allowed to persist in an individual with bad habits and neglectful of health will suffer from the effects of toxemias, infections and improperly distributed weight, and the result will be irritation in these joints. In the most of these cases the deformity comes first, and if this is taken care of they will have a better chance of avoiding more serious complications.

Dr. Zadek: I should like to know what ages were included in this study, for if the patients happen to be thirty to forty years of age, the pain in the shoulder or back would not be of much significance; for most persons over forty have various pains in the joints and back. They have metabolic changes which cause twinges. I should agree with the general trend of the discussion. Many of these patients whom we see complaining of painful feet, if asked how long they have been troubling them, will reply: "as long as I can remember." We see children with weak feet that are not painful, but in later life they are. It is due to a persistent attitude of abduction, and many of these cases are traumatic arthritis.

Dr. S. Epstein: I rise to plead the cause of the middle-aged patient who is crippled by a painful heel, instep, and metatarsus, the sequel of a past infection, who will relate that his teeth and tonsils have been removed, whose intestinal and genitourinary tract have been gone over with meticulous care. I plead that he may be vouchsafed the boon of the strapping of his ankles, as pointed out many years ago by Royal Whitman, to relieve the strain of weakened ligaments and to transfer the body weight to the outer side of the foot. In a conservative manner of speaking, this may be tried as a therapeutic test.

Dr. Benjamin: It seems to me that Dr. Humphries has spoken of two logical groups, one painful because of abnormal architecture and the other because of toxemia. I think that clinically we could often differentiate the two from the history. The cases we see that are due to faulty architecture will tell us that toward the end of the day, after being on the feet, they become painful and sore; and that patient is likely to localize the pain in the astragalus or inner side of the foot; whereas in the other type which is an expression of toxemia he will tell us that when he gets up the foot is sore and that after sitting in a chair and then attempting to get up the pain is excruciating; but after he walks about for a while the pain is relieved. I would like to

know if that is in accord with Dr. Humphries' experience.

Dr. Humphries (closing): I agree with Dr. Whitman that the foot is quite as important a factor as the hand if not more so. Dr. Irish has brought up the question of flat feet, I am frank to say I cannot believe that deformity of the foot is the cause of the troubles, as many people with perfectly formed feet suffer pain and many with absolutely flat feet have no pain at all. I believe that patients treated by shoe makers and instrument makers for their feet conditions are getting very poor treatment, every manufacturer is now trying to make some form of shoe to relieve all the ills man is heir to, it is time we educated the people to the fact that we are not shoe or instrument makers and that pain in the feet may be of much greater significance than they have been led to believe. In most instances we will find on careful examination pain in other joints.

The ages of these patients, ranged from infancy to old age, we simply selected 1000 consective cases for a study; several of these patients had deformity of the feet without pain, they of course required care.

Dr. Epstein has asked about the advisability of local treatment for these painful conditions. In the paper we suggested strapping with adhesive plaster as a temporary means of relieving the pain, this of course is discontinued as soon as the symptoms leave, we believe arch supports and special shoes are contraindicated, not because they do not relieve the symptoms but because people will continue to wear them and in many cases grow worse without feeling any undue pain or discomfort. We have seen many patients who have been relieved of pain in their feet by wearing a special type of shoe gradually develop huge bunions on their feet and Heberden's nodes on their fingers and when they finally are examined it is too late to clear up their condition.

We do not believe that pain in the joints is always due to an infection but rather that it is metabolic. We see many cases who have had their teeth, tonsils, gall bladder and appendix removed still suffering from joint pains.

Overwork and worry are the two principal causes of pain in the feet. After the feet become painful and the patient is hampered in making his living he begins to worry and this aggravates a condition that would otherwise disappear as soon as his worry and overwork were removed.

INTESTINAL OBSTRUCTION

A PRELIMINARY REPORT*

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AFTER careful search of all the literature available, covering the last two decades, we concentrate on two reports, those of Holden of Portland, Oregon[1] and Hayden and Orr of Kansas City.[2] Holden reports the lowest death rate and Orr contributes some new facts that may help to lower yet farther the marvelously low death rate of Holden.

We will endeavor to discuss the chief factors contributing to the unnecessarily high mortality from ileus.

1. The failure to diagnose so simple a condition as bowel obstruction.

2. The reluctance and vacillation of patients. To be taken to a hospital and operated on at once is something that only the more intelligent and better minded will consent to. This failure to diagnose and operate early is a great factor in the cause of death in most instances.

3. The method of operating. Holden has cut the death rate to unbelievable figures. When one of us read Holden's report he bought a ticket to Portland and investigated. It will pay any surgeon in America not familiar with this work to go and see Holden do it and watch the cases recover.

4. We believe that 5 to 10 per cent is too high a death rate and that it can be lowered by attention to after treatment. This is particularly true in so-called dynamic or paralytic ileus. Holden's method with the addition of some modifications is, in our opinion, a definite improvement.

Early diagnosis is readily and accurately made if we pay attention to five cardinal signs and symptoms: (1) severe, sudden colicky pain, persistent and never entirely subsiding; (2) nausea early and persistent. These two symptoms are common to many things but they are slightly different in their manifestation and a skilled clinician soon learns to couple them up with three physical findings that complete the diagnosis so that a mistake occurs less often then in any other abdominal condition. The first sign of blocked bowel is no bowel movement after the third or fourth enema. The bowels may move once or twice from below the obstruction. The second sign: visible peristalsis is seldom seen after eighteen hours, but it may persist for two or three days. This is our most valuable sign. The third sign is an absence of fever. This sign is one of our most valuable diagnostic signs and helps in differential diagnosis. There are, of course, many odd cases that doctors like to talk about. They seem to think that the atypical case is just the thing to look for and much valuable time is lost. Blood chemistry is important and should always be done after the operation as a great aid in treatment.

Roentgen-rays and time consuming tests should never be brought into play if they cause delay. Delay is the big factor, next to the method of operation, which contributes to the appalling death rate. The blood should be taken while the patient is being prepared. A complete blood chemistry with counts and Wassermann test should be done. This procedure should be repeated in twelve to eighteen hours and if any abnormality is present the free use of salt and glucose with insulin is indicated.

OPERATION

The first step after preparation is an incision from a point 2 inches above

* Submitted for publication May 18, 1929.

the umbilicus to a point 1 inch above the simphysis and 1 inch to the left of the midline. The next step is complete evisceration. The point of obstruction is located and the bowel clamped gently above it. A linen suture is passed beneath the peritoneum at four points and a small slit is made in the gut. Holden used a glass test-tube attached to 2 feet of hose. This we have replaced by an enterostomy tube which we like better. The results are the same. The suture is drawn tight and the important step is begun. The operator grasps the gut near the duodenum and presses it between the index and middle fingers with the thumb on the tip of the index finger, the mesentery between. The assistant drags the gut through. The foul contents are expelled into a basin.

Our technique differs from Holden's at this point. We then fill the gut with slightly hypertonic saline and empty this out in the same manner. The intestines are then returned to the abdomen and the obstruction is dealt with. An anastomosis or any other procedure may be carried out. As soon as the intestines are returned, the patient is given a heaping teaspoonful of dry salt by mouth. This is washed down by a glass of water. The patient will feel very much better and will continue to ask for water. The bowels move in from one to three hours and distention is seldom seen. Nausea seldom occurs. The absence of nausea is a great factor.

We have not mentioned narcotics up to this point. In fact narcotics should not be mentioned in connection with obstruction, let alone used. The administration of narcotics in abdominal pain should be a criminal offense and punished as a felony, if ever given before an accurate and positive diagnosis has been made and peritonitis, obstruction and appendicitis ruled out.

Cathartics come in for the same condemnation. Only salt water by mouth may be given.

A few cases are reported with our results:

The first cases are those treated not by the Holden method, and include 1 case of paralytic ileus postoperative in which enterostomy was done, but the complete Holden method was not followed.

Case 1. Mr. P., a man of forty years; had appendectomy and choslecystectomy. Family history unimportant. Patient had been bothered with hyperacidity and gas together with severe constipation for four or five years. Had very poor appetite and frequently took calomel, which made him feel better. Physical examination disclosed nothing remarkable except clear-cut case of chronic appendicitis and gall bladder disease. He was operated on by the old classical method by excision of the gall bladder without drainage. (We do not class the cigarette drainage placed in Morrison's pouch as bile drainage. Drainage in this article in connection with gall-bladder disease always means bile drainage through the stump of the cystic duct or through a tube in the common duct.) This patient developed a paralytic ileus on the fourth day. He was seen by one of us and given salt, but this did not result in anything but temporary improvement. Owing to some misunderstanding, the patient was reported as being in good condition at five o'clock in the afternoon. At four o'clock the next morning the nurse phoned that the pulse rate was rapid and that the patient's temperature was subnormal. An attempt to save life by intestinal drainage was inaugurated, but the Holden method could not be performed in the classical manner, and this case should not be classed as a Holden case. The patient died a few hours after operation.

Case 11. Miss R. M. typical mechanical obstruction of the bowel. Patient was seen by competent physician who made an immediate diagnosis of obstruction of the bowel, incomplete, and ordered her to the hospital for operation. A mechanical obstruction was found near the cecum; this band was cut and the patient made an uneventful recovery. This was an early case and the obstruction had been complete only a few hours before operation.

Case 111. Baby S., nine-months-old infant. This case illustrates poor handling from the start to the finish. The obstruction was

typical and acute, and could easily have been recognized in the first twelve hours. When the case came to operation five and a half days after the onset, the ileum and appendix had all passed through the ileocecal valve and several feet of ileum had wormed its way into the colon and extended as far as the splenic flexure. This mass was removed and anastomosis quickly made. The child was moribund and dying at the time of operation, and the parents were informed there was little chance for life, but they wished the chance taken as they had heard of one or two cases where life had been saved by operation. We undertook to relieve the situation, and the child lived for more than twelve hours after the operation, much to our surprise.

In this case cathartics had been given repeatedly.

Case IV. Mr. C. B. This was an unusual case. We have never seen anything like it and the literature available does not give us any information. The patient presented a typical picture of acute appendicitis with possible general peritonitis or intestinal obstruction. The abdomen was opened under local anesthetic and the entire small intestine was found spastic. This was manipulated after the Holden method without opening the gut, and it seemed to improve the condition, but the gut resumed its spastic condition and did not relax until the patient had been given a teaspoonful of sodium chloride and washed it down with a cup of water. He was taken back to the room and made an uneventful recovery. The gall bladder, which was diseased, was not molested owing to the man's condition; he was told this would have to be removed later. This was a case of spastic ileus and we cannot account for it.

The above cases complete the series of obstruction cases that were not handled by the Holden method and show 4 cases with 2 deaths, a mortality of 50 per cent. This is on a par with the average death rate throughout the world in cases that are mishandled before they come to the surgeon. The best statistics are those of Braun, who records 35 per cent deaths in intestinal obstruction.

We present the following cases almost as badly handled, some even worse, in which the Holden method was used.

Case V. Miss E. B. This patient had quite a lengthy history which need not be entered into here. Suffice it to say that she had had three operations previous to this obstruction. The obstruction was due to a loop of gut passing behind a band of adhesions. The strangulation was complete. The patient had the acute onset seventy-two hours before she was operated on. She was seen by two different doctors, given morphine and enemas, and when finally seen by one of us was ordered into the hospital for immediate operation, to which she consented. At this time she was having fecal vomiting and marked distention. The obstruction was found and obliterated; the gut was opened and drained and the patient moved back to the room without any apparent shock; she made an uneventful recovery and left the hospital on the ninth day. Temperature at no time ranged above 100.2°F.; pulse rate at its highest was 110. The postoperative chart would be about the same as an ordinary appendicitis case; there was never any distention or anything to alarm; no record of vomiting.

Case VI. Miss E. N. This patient came into the hospital vomiting fecal matter, semi-comatose with leucocyte count of 38,000; had been returning clear enemas for two days. After vomiting fecal matter, it was suspected by the physician that she might possibly have an intestinal obstruction, but said he would not decide definitely until he returned from church.

The patient was rushed to the hospital and operated on by the Holden method. Bowel was found completely obstructed, and castor oil and probably many other cathartics cleared out of the bowel through the Holden tube. A very solid fecal mass had been banked up behind a fibrous band; during the operation the tube was dislodged and the operating field soiled with intestinal contents. The patient was given a teaspoon of salt before she left the operating room and the operation was performed under local anesthesia. Postoperative course in this case was uneventful. Highest temperature was 101.2°F.; had very slight intestinal distention, no nausea, no vomiting. The pulse rate dropped, after operation, to 90 and never went above that after the second day. She left the hospital in an ambulance on the fifth day, with temperature normal and pulse rate of 72.

Case vii. Mr. D. This was a postoperative mechanical obstruction occurring at the hepatic flexure of the colon. It was recognized early, the patient retching and breaking the stitches of his wound. Intestines immediately appeared through the wound and it was seen that a definite obstruction at the hepatic flexure of the colon was present. This had not been present very long, as the patient was apparently in good conditions the evening before, although the obstruction might have been present for two or three days but incomplete. The band was cut, the intestines untangled, a Holden drainage done and the patient returned to the room. He left the hospital six days later in good condition; had no further postoperative trouble.

Case viii. Mrs. M. S. This was a mechanical obstruction and was diagnosed early, but not early enough as distention was quite marked; at the time of operation it was deemed advisable to place a catheter in the ileum near the cecum; this, I believe, was unnecessary, and the patient would probably have lived without it. I should have stuck strictly to the Holden method in this case and would have saved the patient some weeks of discomfort. This fistulous tract closed up in five weeks. The patient did not remain in the hospital all this time but the obstruction in the bowel was the cause of two weeks in the hospital which would otherwise have been unnecessary. The obstruction followed the removal of a very large fibroid tumor.

Case ix. Mrs. M. C. Mexican woman with strangulated hernia of four days' duration with much fecal vomiting. The usual incision was not made, but a very much longer incision than the average hernia operation. She was eviscerated, as in the other cases, without any extreme difficulty; the intestine was cleaned twice and filled with salt water; the patient was given 2 teaspoonfuls of salt, the hernia repaired by the McArthur method and the patient returned to her room. The wound became infected with colon bacillus, but the suture held and the patient left the hospital in excellent condition three weeks after admission.

This case and the following case are the two outstanding cases which show that the Holden method, plus the administration of salt by mouth, is the important factor in the prevention of death from intestinal obstruction.

Case x. Miss L. P. For eight days this patient had not had a bowel movement; had been seen by seven physicians and one neighbor woman, and two physicians and the neighbor woman diagnosed it as obstruction of the bowel. One of the other five physicians who were uncertain was however suspicious when the patient vomited fecal matter on the fourth day. She had been vomiting fecal matter at intervals for four days. The Holden method was used in operation, and the patient was given a teaspoon of salt with two full glasses of water on the table. The postoperative course was uneventful. Temperature never rose above 101.3°F.; it dropped to normal on the fourth day and stayed there. The highest pulse rate was 120; this dropped to 90 on the fourth day and remained below 90 until the patient left the hospital on the tenth day. The postoperative course was remarkably free from nausea and vomiting, and the records were about that of any ordinary abdominal operation.

This gives 6 cases of mechanical obstruction with no deaths. Of course the number of cases is too small to compare with Dr. Holden's statistics of 135 cases in which he reports a death rate of 19.2 per cent and less than 5 per cent in his personally seen cases.

This is only a preliminary report and is made in the hope that those who are having too many deaths from intestinal obstructions will pay more strict attention to emptying the gut and the use of saline intravenously and by mouth in the postoperative treatment in these cases.

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DISCUSSION

Dr. Thomas W. Woodman: When I was with Dr. Sweek, treated 4 cases of intestinal obstruction by the Holden method. These had been obstructed for from two to six days at the time of operation. I had not read Dr. Holden's article when we first did one using his method, nor did I know that Dr. Sweek

was going to use this method. We evicerated the patient, placed a tube into the bowel close to the point of obstruction, then Dr. Sweek advised me to start at the duodenum and strip the bowel between his fingers until all of the bowel was empty. I felt before this point in the operative procedure had been arrived at, that there was some question as to his sanity, and when he advised me to further apparently traumatize the bowel in the manner described I was sure that he had gone temporarily insane, but there seemed to be nothing to do except go ahead and assist in the murder. I noted, however, that as soon as we had completely emptied the bowel and had washed it out thoroughly with salt solution, peristaltic waves were present, and the patient seemed in better condition than she had been at any time during the operation. Despite this I firmly expected to see the patient the following morning with a definite and decisive paralytic ileus. This however was not present and the postoperative progress of that patient was about the same as in the removal of a chronic appendix.

I do not feel that the writers have sufficiently emphasized the work of Hayden and Orr of Kansas City several years ago on the use of salt in intestinal obstruction. The rise in chlorides contained in the blood stream when salt is given by mouth is tremendously important and I do not feel that this had been sufficiently emphasized. Saline proctoclysis does not answer the purpose. Another important service rendered by salt is the increase in peristalsis that is immediately set up and the elimination of toxic material from below. Another point not mentioned in this paper is the use of 15 per cent sodium chloride intravenously; 75 c.c. of this should be given through a No. 20 needle. The patient will sometimes have a bowel movement within five minutes of the injection. Holden does not mention the use of salt and after a study of these cases and of Holden's paper, I am of the opinion that the use of salt freely and properly in intestinal obstruction is a valuable contribution. Another thing not sufficiently emphasized is the smooth postoperative course these patients have, the freedom from vomiting, and the general well-being of the patient a few hours after operation.

It is my opinion that following the method of Holden in intestinal obstruction as Sweek and Patterson have outlined here will go far toward reducing the mortality.

ELECTROSURGERY IN THE TREATMENT OF UTERINE CERVICAL LESIONS*

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ELECTROSURGERY is accomplished by the transition of heat through the tissues of the body. This heat may be regulated to produce coagulation, desiccation or carbonization.

Lesions of the uterine cervix which respond to this treatment may include any pathogenic condition of this structure. The most common is an erosin. This varies in size, extent, depth and duration in indirect proportion to its etiological factors. The following types have been recognized and differentiated: simple, annular, sectional, serrated, dual, triple or multiple with or without ectropion; granular, papillary or follicular; benign, premalignant, or borderline with some evidence of degeneration which can only be verified by microscopical examination of the biopsy specimen. Other lesions which respond to this form of treatment include small nodular fibromata in the outer surface of the cervix, Nabothian cysts appearing as small blebs in the outer surface, pedunculated polypi originating in the mucosa of the cervical canal, multiple polypi appearing about the rim of the external os, leucoplakia involving the mucous membrane of the outer surface of the cervix, and chronic infection of the mucous glands in the cervical canal.

The object of this discussion is to present the premises pertaining to the indications and contraindications for this method of treatment; to explain the technique of application and to describe the important details in the follow-up treatment, which procedure must be given particular attention in order to get satisfactory end-result.

Any abnormal or pathogenic lesion involving the outer mucous membrane of the cervix or the mucosa of the cervical canal may be removed with electrosurgery. If the lesion involves the adjacent vaginal structure great care should be taken to avoid perforation of the vaginal wall and injury to the bladder or the rectum. If the lesion is in the cervical canal it may be removed definitely by producing a coagulation of the diseased tissue.

There are no absolute contraindications for the use of electrosurgery in the treatment of lesions in the cervix but there are several contingent ones depending upon other complications, which in turn are amenable to local or constitutional treatment. Active lues, a Vincent's spirilla or fusiform bacillus infection, advanced diabetes, or any constitutional condition which might retard or prevent the final healing of the tissues after the coagulum sloughs off or separates, are a few of the contingent contraindications.

Intensive antiluetic treatment is indicated until the Wassermann test is reducted or negative. Even though the reaction to the Wassermann test is slightly positive after several intravenous injections of the arsphenamine preparations, it is admissable to electrocoagulate the lesions because this form of treatment induces a rapid healing of the remaining normal structure, especially after the coagulum has sloughed or cleaved away.

When Vincent's spirilla or fusiform bacilli are present the coagulum becomes very malodorous. The adjacent healthy tissue becomes extensively involved. These organisms thrive in the devitalized tissue and retard the repair processes. This inflammatory condition should receive preliminary treatment with a 10 per cent aqueous solution of Copper Sulphate or Arsphenamine in glucose or glycerine. If this infection does not respond to these

* Submitted for publication May 31, 1929.

local applications then intravenous injections of neo or sulpharsphenamine are indicated. These organisms are occasionally found in the cervical and vaginal regions, therefore it is very important to make a microscopic examination of the stained smear.

Several microscopic examinations of the smears taken from the vaginal excretion, the mucopurulent discharge from the cervical canal, and the exudate on the surface of the lesion should always be made before electrosurgery is applied. The presence of the pyogenic organisms is not a contraindication for immediate treatment because the heat generated in the tissues of the lesion will invariably destroy all of these bacteria.

It has been definitely determined that a temperature of 106°F. will destroy the Neisserian infection. It requires a higher temperature to destroy the other pyogenic organisms frequently found in these lesions. A temperature sufficient to produce coagulation invariably destroys all the pyogenic bacteria present in the lesion and the adjacent apparently normal tissue.

The erosion is a definite focus of infection, which in turn is the cause of secondary lymphadenitis and phlebitis involving the veins of the broad ligament and uterus. In addition to this there is a generalized toxemia proportionate to the virulency of the organisms. The sallow complexion, the anemic appearance, the neuropsychasthenia and myesthenia are a few of the manifestations of the constitutional results of these focal infections. The functional deficiencies and the glandular dyscrasies may be included also in the chain of complications due directly or indirectly to these lesions.

TECHNIQUE

Directions for operating the electrosurgical apparatus are supplied by the manufacturers or their detail men, therefore it is superfluous to recite these facts here.

After the cord conducting the current to the patient and the return cord to the apparatus have been properly inserted in their respective terminals, definite consideration must be given to the kind of electrode to be used in making proper contact with the lesion. There are available several very convenient electrode carriers composed of a small insulated cord having a vulcanite handle designed to hold a small aluminum wire of various lengths which may have a blunt or pointed end. This type of electrode is inexpensive and very appropriate for any kind of electrosurgical treatment necessary to produce electrocoagulation, desiccation or carbonization in the region of the cervix. Many very elaborate sets of electrodes, points, blades, rods and blunt surface metallic tips plated with gold have been devised by the manufacturer. These electrodes are not necessary for efficient work nor are they convenient because the connecting cord is too heavy and cumbersome.

The cord going to the indifferent terminal of the electrosurgical machine should have attached to it a flat piece of block tin, 4 by 6 inches or 6 by 9 inches in size. This should be applied in close contact with the abdomen or the back of the patient. It is necessary to place the patient in the dorsal or lithotomy position on a table preferably made of wood, but there is no particular objection to placing the patient on a metal table as long as the metal parts of the table are not brought into direct contact with the skin of the patient and are not grounded.

A very practical method of completing the circuit to the indifferent terminal of the apparatus is to interpose an assistant. This is done by having the assistant hold the small aluminum hand applicator, connected to a cord running to the indifferent terminal and then placing the palm of the other hand flat on the abdomen or thigh of the patient. With this set up the patient may be reassured that there will be no unpleasant electrical shock felt because the current must pass through the assistant first. During the operative procedure

the assistant is in a favorable position to regulate the rheostat of the apparatus and watch the reactions of the patient.

The kind of speculum best adapted for use while the lesion is being treated is a mooted question. The De Vilbis bivalve is the most convenient because the blades can be regulated and steadied with the left hand while the right hand is engaged in holding the electrode. This style of speculum can be manipulated without discomforting the patient. The blades of proper size can be separated sufficiently to keep the vaginal walls in the clear, at the same time steading the cervix between the ends of the blades. A tubular glass or vulcanite speculum may be used in place of the bivalve metal one. This method of procedure may be followed with or without placing the patient under a general anesthetic. When under a general anesthetic the weighted speculum may be used and the cervix drawn down toward the entroitus with a heavy tooth tenaculum forceps; care should be taken not to allow the handles of the forceps to come in contact or press upon the upper surface of the vagina or the area about the meatus of the urethra. If this is done coagulation of the mucus membrane which is brought in contact with the metal will occur. A coagulum in the zone about the entroitus or the meatus of the urethra heals slowly and causes considerable discomfort.

After the cervix has been steadily presented between the blades of the speculum, the point of the electrode is gently applied to its surface while the electrical current is turned on, and is slowly moved over the surface of the lesion which turns white. Then the point of the aluminum wire is plunged into the lesion to a depth sufficient to obtain the coagulating effect necessary for ultimate removal of all abnormal tissue. This part of the process is repeated at various points until the entire lesion is converted into a firm coagulum. If the coagulum is massive the outer portion may be desiccated and even carbonized to shrink it so that it can be curetted. The carbonized portion usually adheres to the end of the wire and is easily teased off each time the aluminum point is drawn away.

Special care should be taken not to extend the coagulation into the musculature because this retards the healing process and frequently is followed by excessive bleeding and the formation of excessive granulomatous tissue, which must be treated with astringent preparations. Usually a 10 per cent solution of silver nitrate will control the bleeding and prevent the granulations from getting exuberant. The 10 per cent aqueous solution of copper sulphate may be used when the granulations are not excessive and milder astringent action is required. Sometimes it is necessary to desiccate the bleeding point by sparking the surface about the blood vessels or capillaries. This is done by holding the point of the wire about a millimeter away from the surface. Occasionally the patient will notice the electrical effect and complain of a tingling sensation; but never enough to resent a repetition of the treatment when reassured that no harm will result.

The technique just described may be modified to meet all peculiar and unusual variations from the common types of lesions in the cervix. Each operator must develop after considerable experience his own special technique to solve the problems which confront him.

TREATMENT OF NEOPLASMS

Any small tumefaction on the vaginal surface of the cervix may be treated with electrosurgery when applied with the coagulating effect sufficient to destroy the entire lesions. When the coagulum sloughs a small crater will be left. This fills in with granulation tissue and eventually forms a soft elastic fibrosis. If granulations get exuberant an astringent may be applied until a new smooth surface reforms.

Pedunculated papillomata and mucous polypi occurring in and about the external

os are easily removed by coagulating the stem or pedicle and then excising through the coagulated portion and obtaining a complete and immediate removal of the tumor with its pedicle. This can be done without any hemorrhage. The coagulated stump passes through the usual order of desquamation and healing.

Nabothian cysts which may occur in various numbers in the zone about the external os can be removed by puncturing them with the point of the aluminum needle and then turning on sufficient current to cause a thorough desiccation of the structure of the cysts and incidentally destruction of any bacteria which may be present; slight coagulation of the capsules will produce more definite and permanent destruction of the cysts. After the coagulum cleaves off the small crater which is left, fills in and the region reforms with a smooth surface.

TREATMENT OF ENDOCERVICITIS

Endocervicitis has been the bane of gynecological practice, especially when the mucous glands become deeply infected. The thick mucopurulent discharge present becomes so persistent and resistant that the patient gets disgusted with her condition. Radicle amputation, enucleation or even extensive actual cauterization may seem to be the only solution of this problem.

Electrosurgical treatment with the heat limited to a point below the coagulating degree has proved efficacious. This technique has been tried and proved dependable. The regular set-up already described for coagulation by the use of electrosurgery can be utilized. The bare end or uninsulated portion of the aluminum wire is wrapped with a small piece of absorbent cotton, which is saturated with a 10 per cent solution of silver nitrate. The milliamperage is regulated to range about 150; not enough heat to coagulate but only enough to elevate the temperature from 106°F. to 115°F. This degree of temperature is presumed, because the microscopic examination of the smears taken from the cervical discharge after a few treatments show a disappearance of the bacteria. Two or three treatments of ten minutes' duration divided in three intervals of three minutes' continuous flow of current with a minute rest at each period will make a remarkable change in the character of the discharge. A thick mucopurulent discharge changes to a clear flow of mucus. If this mucous discharge is excessive it will diminish after a few positive galvanic copper cataphoric treatments.

If these methods of treatment fail to clear up the discharge and destroy the infection, then there must be a persistency of excretion from a higher level in the cervical canal. More radical procedure will be required if a chronic infected tube or some lesion in the fundal portion of the uterocervical canal is present. Surgery is definitely indicated in these complicated conditions.

CONCLUSIONS

Electrosurgery is the most conservative method for the treatment of uterine cervical lesions.

Electrosurgery is more efficacious in treating erosions and chronic infections of the cervix than any other method.

Electrosurgery destroys infection and produces an end-result which does not impair the function of the musculature of the cervix.

Electrosurgical methods of treating the chronic Neisserian infection has proved reliable.

The final results of extensive coagulation of cervical erosions complicated with lacerations do not interfere in any way with successful plastic operations for repair but leave a clearer and cleaner field for this procedure.

The medical profession as a whole and obstetricians or gynecologists in particular should give electrosurgery as a therapeutic agent careful consideration and respectful recognition in so far as it is valuable as a method of conserving the function of the

regenerative organs and preventing the incidence of cancer of the cervix.

To substantiate the efficacy of electro-coagulation in the treatment of cervical lesions a brief resume of a few records of several patients treated by this method will suffice.

Mrs. A. T., aged forty-seven, iv para, complained of a vaginal discharge which occurred occasionally. She had been nauseated for the preceding month. Her breasts were sore and sensitive. She had a backache in the lumbar region and pains in her joints, especially in the lower spine radiating down the right leg. She complained of a frequent urge to urinate and pain in the anal region when she passed a constipated stool. She presented herself for diagnosis and treatment October 22, 1927 and stated that her last menstrual period was July 29, 1927 and that she flowed only two days. Her menstruation began at seventeen years of age and had been regular since the last baby was born three years previous. Physical examination revealed an enlarged fundus with a pronounced extention of the enlargement into the right broad ligament region. The cervix uteri was enlarged to an extent three times the normal average size. There was an extensive granular erosion in the zone of the external os and a red pedunculated tumor protruding through the external os. She was sent to the hospital November 3, 1927 for a further diagnostic and pathologic check-up of her general condition preparatory to the removal of the cervical polyp and electrosurgical coagulation of the cervical erosion. This was done without a general or local anesthetic. A diagnosis of an approximate nine weeks' pregnancy in addition to the other conditions was made. Microscopic examination of smear revealed mixed pyogenic bacteria.

After consultation, removal of the polyp and treatment of the erosion with electro-surgery was determined as the proper treatment. Precautions were taken not to interfere with the progress of pregnancy. This treatment was given November 4, 1927 and the patient discharged from the hospital November 7, 1928 with a final diagnosis of cervical erosion and a benign cervical polyp. The microscopic findings revealed glands dilated and filled with mucoid substance, cells regular in outline, with fibrous tissue present. She received the regular follow-up local treatment consisting of applications to the cervical region of 5 per cent aqueous soution of mercurochrome. Several times a 10 per cent solution of copper sulphate was substituted until the eroded area of the cervix had been completely resolved to a normal condition; she went on to the full term of pregnancy and gave birth April 25, 1928 to a normal healthy child without any complications. She returned three months after the baby was born for a checkup of the condition of the cervix which presented a slight granular eroded zone near the external os. This required only a superficial electro-coagulation. The coagulum cleaved off in about ten days and then left a normal appearing surface on the cervix.

Several similar records are available to substantiate the fact that electro-surgical treatments may be administered to the cervix of a gravid uterus without interfering with pregnancy if due care and precautions are taken not to traumatize the contents of the fundus.

Mrs. R. S., aged thirty-three, v para, complained of persistent vaginal discharge, backache, excessive flow of menstruation (at times for ten days), irregular menstrual periods, was very nervous and hypersensitive to noises, with severe headaches. Diagnosis: multiple lacerations of the cervix and papillary erosions with extropions; also fibrosis of the fundus uteri. Miscroscopic examination of smear revealed a mixed pyogenic bacteria flora. Treatment indicated: electrocoagulation of the erosions, dilatation of uterocervical canal, diagnostic curettage and interuterine application of 50 mg. of radium sulphate in platinum needles inserted in a Schmidt applicator composed of 1.0 mm. brass, 1.0 mm. vulcanite, 1.0 mm. para rubber for forty-eight hours; equivalent to a 2400 mg.-hr. dose of the radium element. She entered the hospital August 31, 1928 and received this treatment under a nitrous oxide gas, oxygen and ether anesthesia. She left the hospital Sept. 6, 1928. She received local treatment of the cervical lesion every other day. Check up of her condition September 29, 1928 revealed a normal condition of the cervix and decided improvement in her general health.

Mrs. F. R., aged twenty-two, primipara, complained of soreness for the preceding

four weeks in the lower abdomen in each side; this discomfort was aggravated when standing on her feet and after eating; also leucorrhea for the preceding four weeks. Microscopic examination of the smear taken from the mucopurulent discharge from the cervix was made August 6, 1927. It revealed a lot of pus cells and extracellular gram-negative diplococci. She received four intracervical electrosurgical treatments every other day. These were administered with the aluminum wire wrapped with cotton saturated in a 10 per cent solution of silver nitrate. During the first four days she received two intravaginal infrared ray treatments for forty-five minutes, two days apart. All symptoms of discomfort subsided; the discharge ceased and the excretion from the cervical canal was free from pyogenic bacteria when the last microscopic examination was made.

ERYTHROBLASTS AND MYELOCYTES IN TRAUMATIC EFFUSIONS OF THE KNEE JOINT

THEIR SIGNIFICANCE FOR THE DIAGNOSIS OF INTRA-ARTICULAR FRACTURES*

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IN a previous paper[1] we called attention to the appearance and significance of fat in traumatic effusions of the knee joint. It is present in severe injuries, which involve the interjoint ligaments and cartilages alone, or combined with intra-articular fractures. The demonstration of fat permits, therefore, to differentiate severe from slight injuries of the knee joint.

It is also evident that we have to search for other elements, if we are to decide from the examination of joint fluids whether the intra-articular surfaces of the joint have remained intact or did suffer by the injury.

The following deduction seems to be in place: In case of intra-articular fracture, elements of the bone marrow will reach the joint cavity. The red marrow of the epiphyses contains besides other cells erythroblasts and myelocytes. These two elements, demonstrated in a joint fluid, will therefore settle the diagnosis of intra-articular fracture. Consequently, we would be able to complete the differential diagnosis of injuries to the knee joint from the aspirated effusion: slight injuries, where fat is absent; severe injuries, when fat is found; intra-articular fractures, where elements of bone marrow are seen besides the fat.

The following is an account of our work in this direction:

By means of a simple technique it was possible to concentrate the erythroblasts and myelocytes in hemorrhagic knee joint fluids. The demonstration of these elements was thereafter a matter of routine. Our results were studied and compared with the clinical and roentgenological findings.

TECHNIQUE

Acute traumatic effusions are as a rule hemorrhagic. The blood is not coagulated, the corpuscles being suspended in the fluid. Centrifugalizing for ten to fifteen minutes therefore separates the different elements in layers. The blood corpuscles form the sediment at the bottom of the centrifuge tube; the fluid collects above. Fat, if present, forms one or two layers on top of the fluid, as we have described elsewhere.[1]

The blood sediment contains elements of different specific gravity. The lymphocytes and leucocytes, as well as the cells derived from bone and synovial membrane, are lighter than the erthrocytes. The neucleated cells therefore will concentrate at the top, which can often be distinguished as a whitish disk from the sediment of red cells. In order to examine for erythroblasts and myelocytes, the supernating fluid should be pipetted off carefully and smears prepared from the top of the blood sediment, using one of the following methods: by turning the centrifuge tube in a horizontal direction, frequently the top separates from the rest of the sediment and can be slipped into a dish and spread on microscopic slides; or material from the top is aspirated with a pipette and transferred on slides. Thin films can also be prepared by dipping a fine camel's hair brush in the top of the blood layer; the brush is then carried with a gentle stroke across the surface of

*Submitted for publication May 31, 1929.

the slides. This is especially helpful in dealing with sediments which are sticky and do not spread readily, due to fat and viscous secretion in the fluid. This factor does also interfere with the staining process and makes careful work necessary. The films must be thoroughly dried; the dyes employed should be of good quality. Any of the routine blood stains (Wright, Giemsa, May-Grunwald and Papenheim) are satisfactory; about twice the length of time used for staining blood smears should be allowed. We obtained the best results with Jenner stain, leaving the concentrated dye for three minutes and afterwards diluting and differentiating with an equal amount of water for five minutes. We dry the slides without blotting, and control the stain under microscope. In case the nuclei are only weakly stained we transfer the slides for five or ten minutes in a highly diluted solution of Delafield hemotoxylin (5 drops of the stain to 25 c.c. of tepid water.) After drying, the films are ready for study under the high power dry and oil immersion systems. The results are best in effusions aspirated in the first seven days after the injury. Older effusions undergo hemolysis and reduction of the hemoglobin which gives a dark brown coloration to the fluid, making it difficult to recognize the whitish ring on the top of the blood sediment. The cells also suffer and do not stain so well. The examination of such effusions is greatly improved by mixing the fluid with equal or twice the amount of normal saline solution before centrifugalizing. This process can be repeated if necessary after pipetting off the supernating fluid from the sediment in the centrifuge tube.

CYTOLOGICAL DIFFERENTIATION

The nucleated cells are concentrated up to one hundred times in films prepared from the top of the blood sediment. They are derived from three sources:

1. Mesothelial or endothelial cells from the synovial membrane. They are large, mononuclear cells (*ca.* 20 in diameter) of round or polygonal circumference. The nucleus is relatively small, round or oval. Nucleus and plasma take the stain fairly well and evenly; granulations are absent, vacuoles rare. This gives the impression of a flat surface. These cells are scarce in acute hemorrhagic effusions; it is, however, important to differentiate them from the myelocytes.

2. Leucocytes, derived from the circulating blood. Polynuclear neutrophiles are prevalent, next come lymphocytes. Due to the concentration eosinophiles and basophiles, transitoric cells and monocytes, are also more frequent than in blood stains. These cells, while present in every hemorrhagic effusion, make up all the nucleated elements in injuries that do not involve the articular surfaces of the knee joint (Fig. 1).

3. Exclusively in intra-articular fractures we find erythroblasts and myelocytes, derived from the bone marrow. The relative number of these cells varies in different fluids. Figure 3 shows numerous erythroblasts, Figure 2 only one, in a group of myelocytes.

The erythroblasts (Fig. 3) most frequently seen are normoblasts: they are larger than red cells; their plasma is of a darker shade, flat, and contains a small, deeply stained nucleus, which is always eccentric and often touches the periphery. The nucleus is in a good number of cells split up in two or four fragments. Occasionally a vacuole is seen in the plasma. Besides the normoblasts we noticed a number of smaller and few larger nucleated red cells (microblasts and macroblasts, respectively). The erythroblasts are easy to recognize; the only other nucleated cells of their size in our films are the lymphocytes. These have a very narrow strip of plasma; the nucleus practically fills the whole cell.

The myelocytes (Fig. 2) are mononuclear, large cells (15 to 25 m.m. in diameter), of round circumference. The plasma, faintly stained, contains granula of dif-

ferent size and staining properties. Cells with fine, neutrophile granulations are in majority; a considerable number show coarse eosinophilic granulations. Myelocytes, with coarse, basophilic granules, are quite rare. The nucleus is round, centrally situated, and fills about half of the cell. It takes the stain unevenly; dark granules alternate with vacuoles while the rest of the nucleus is only moderately stained, thus giving the impression of a mosaic or meshwork.

The periphery is often more intensively stained than the center of the nucleus. Fat droplets are seen in both plasma and nucleus. The identification of the myelocytes is based on the granules and character of the nucleus. The other mononuclear cells in the smears (synovial cells, macrophages, monocytes and lymphocytes) do not have granulations. Both plasma and nucleus are comparatively deeper and homogenous stained. Specially, eosinophile granulations make the recognition of myelocytes easy. The mosiac appearance of the nucleus is another valuable point, and useful when the plasma is not very distinct.

Erythroblasts and myelocytes in the smears indicate an intra-articular fracture, with the only exception of effusions in patients with leucemia and pernicious anemia. These conditions, however, produce other symptoms and can be excluded by an examination of the blood. The blood picture in our cases was normal.

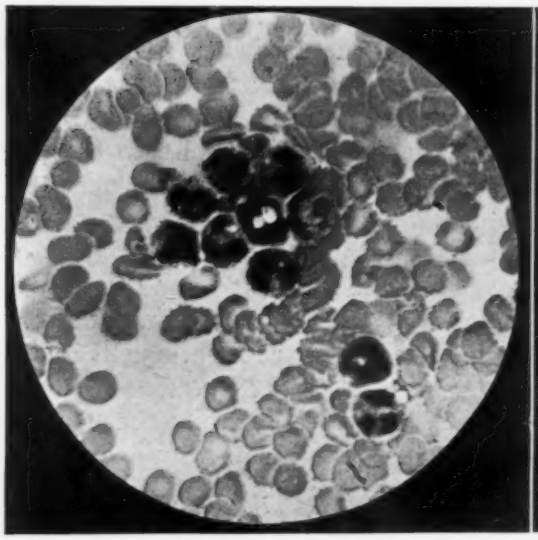

Fig. 1. Concentrated sediment from hemorrhagic fluid without fat: Red blood cells and group of polynuclear leucocytes. Case of traumatic synovitis. Roentgenogram negative. (Jenner stain, × 800.)

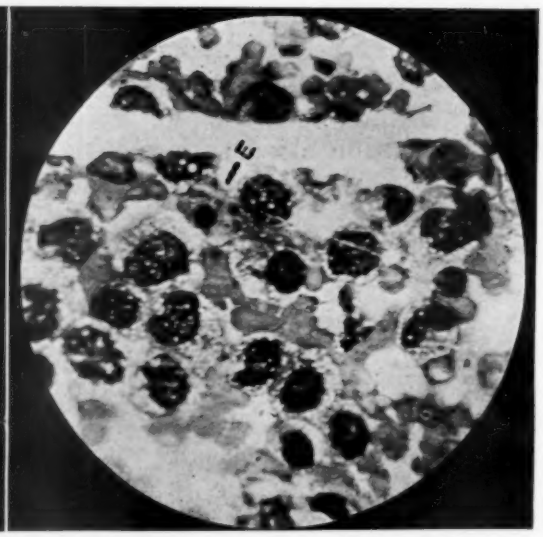

Fig. 2. Concentrated sediment of hemorrhagic effusion with fat: red blood cells, numerous myelocytes filled with fat droplets. E, erythroblast. Case I. Roentgenogram negative. (Jenner-hematoxylin stain, × 800.)

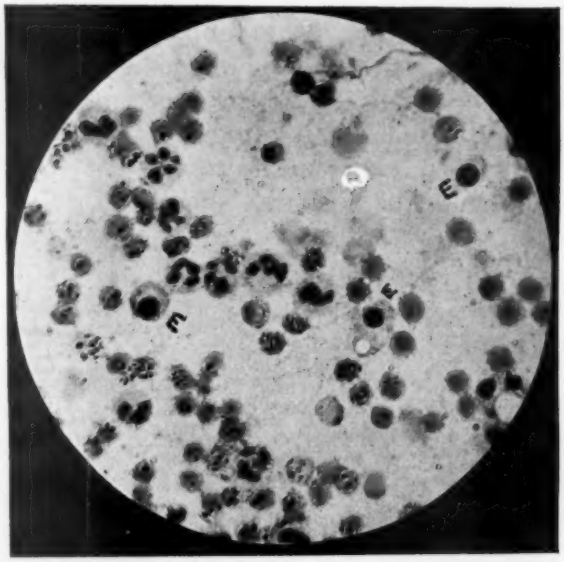

Fig. 3. Concentrated sediment of hemorrhagic effusion with fat: red blood cells, polynuclear leucocytes. E, erythroblasts. Case III. Roentgenogram positive for fracture. (Jenner stain, × 800.)

On the other hand, erythroblasts and myelocytes can be missing in fractures involving the knee joint, when the bone marrow is atrophic or degenerated. Fatty and mucoid degeneration are quite rare, except in marantic and very old subjects. Fibrotic changes were observed in Paget's disease, ostitis fibrosa and osteomalacia. Our patients were males in good physical condition, of an average age of forty-one years, ranging from twenty-two to sixty years; they were not suffering from the mentioned bone conditions.

Fig. 4. Anteroposterior view of left knee. Case 1. Roentgenogram negative for fracture.

Fig. 5. Lateral view of left knee. Case III. A, free fragment of bone, suggesting old injury.

ANALYSIS AND COMPARATIVE STUDY

We examined the concentrated sediments in 32 cases of acute traumatic hemorrhagic effusions of the knee joint, and found erythroblasts and myelocytes in 7 cases (21.9 per cent).

The smears in 25 cases (78.1 per cent) contained only elements of the cirulating blood (erythrocytes, leucocytes, lymphocytes) and few synovial cells (Fig. 1). Our material can be divided in two groups with regard to the fat contents of the fluids.

In 21 cases (65.6 per cent) the fluids separated upon centrifugalizing in two layers: blood corpuscles and serum. Fat was absent. Clinically they represented cases of bursitis and synovitis: suprapatellar bursitis, 5; prepatellar bursitis, 10; synovitis, 6 cases. They were minor injuries; symptoms of damage to the internal structures of the joint were absent; roentgenograms were negative; the smears did not show elements of bone marrow. All made good recoveries in from one to three weeks.

The second group consists of 11 cases (34.4 per cent), containing fat besides the blood. The fluids separated in the centrifuge in three or four layers: blood corpuscles, exudate and fat on top. Seven (63.6 per cent) cases in this group were positive, and 4 (36.4 per cent) of these cases were negative for erythroblasts and myelocytes in the films. Clinically, these 4 cases represent injuries to the soft interjoint structures: rupture or stretching of the anterior crucial ligament and medial semilunar cartilage, 1; rupture or detachment of the internal semilunar cartilage, 3 cases. Roentgenograms were negative for fractures.

Fig. 6. Anteroposterior view of left knee. Case iv. Fracture of lateral condyle and spine of tibia and head of fibula. Periosteal reaction of tibia suggesting old injury.

We are now ready to consider the 7 cases with myelocytes and erythroblasts in the smears. The roentgenograms revealed intraarticular fractures in 5 instances:

1 and 2. Fracture of the patella.

3. Fracture of the inner condyle and avulsion of the medial spine of the tibia.

4. Infraction of the lateral condyle of femur, free piece of bone in joint (pictures suggesting old injury; see Case iii and Fig. 5).

5. Fracture of lateral condyle and spine of tibia and head of fibula (these pictures also suggest not recent trauma; see case iv and Fig. 6).

Two cases in this series, with bone marrow elements in the sediment, were diagnosed as internal derangements on the strength of negative roentgenograms. But the demonstration of erythroblasts and myelocytes indicates positively an intraarticular bone injury, consisting of infraction of the articular surfaces without deformity, and therefore not reproduced on the roentgenogram.

A recent paper, by Herbert S. Steuer,[2] offers anatomical proof of this view. Steuer studied 16 fractures of the tibia involving the knee, in skeletons, at the Hamann Museum, Cleveland, Ohio. Four of these (25 per cent) were cracks in the articular surface and avulsion of the eminentia, which did not photograph on the roentgen plates.

Short abstracts of our roentgenographically negative cases will illustrate the value of cytological examination:

Case 1. C. A., twenty-two years old, laborer, while handling a heavy box, slipped and twisted the left knee, on September 14, 1928; no previous injury to this joint.

Findings: Considerable swelling over inner aspect of left knee. Tenderness and pain over affected area; limited and painful extension and flexion.

Aspiration three days after injury of 90 c.c. of hemorrhagic fluid. Numerous fat droplets floated on the surface. Upon being centrifugalized, the fluid separated into three layers. At the bottom blood corpuscles 1½ inches high: the top of this layer formed by a whitish ring about 1/10 inch; above a layer of amber,

cloudy fluid, 2¼ inches high. The top is formed by solid fat (palmitin and stearin ⅛ inch thick) and a trace of liquid fat (olein).

Roentgenograms were negative for fracture, both views. Figure 4 gives the anteroposterior view.

Clinical Diagnosis: Rupture or detachment of internal semilunar cartilage.

Cytological Examination of Top of Sediment: Red cells, leucocytes, numerous myelocytes, partly filled with fat droplets; some erythroblasts. (Fig 3.)

Blood picture normal.

Therapy and Progress: Knee was put in a cast, which was removed in eight days; elastic bandage applied afterward. Under physiotherapy, swelling diminished gradually. Flexion still impaired after a month, but patient able to work. After two months no pain on motion; knee still swollen at the inner aspect.

Case II. J. W., thirty-two years old, was severely struck by a cable on right knee, on May 19, 1928. He could not get up and was immediately transferred to the hospital. No previous injury to this knee.

Findings: Abrasion at the outer side of right knee; the joint swollen, tender, patella floating; flexion and extension limited and painful.

Aspiration at date of injury of 40 c.c. of hemorrhagic fluid, centrifugalizes in four layers. At the bottom blood corpuscles 1½ inches high, followed by turbid, yellow, serous exudate; third layer consists of 1/10 inch of solid fat, above which a thin film of olein is spread.

Roentgenograms were negative for fracture.

Clinical Diagnosis: Severe sprain; injury to external, lateral ligament and eventually semilunar cartilage.

Cytological Diagnosis: Besides blood and synovial cells numerous myelocytes and erythroblasts.

Blood picture normal.

Therapy and Progress: Hot compresses and elevation of the leg. Massage and physiotherapy later; walking with crutches. Two months' disability.

Reviewing our material we come to the following conclusions: Out of 32 cases of injuries to the knee joint, roentgenography revealed fractures in 5 cases (15.6 per cent); the cytological diagnosis was positive for elements of bone marrow in 7 cases (21.9 per cent). This makes a difference of 6.15 per cent for the whole series. The percentage of positive results obtained by the cytological method is still larger, if we consider the severe injuries alone. Out of 11 cases in this group, roentgenography was positive in 5 cases (45.5 per cent) and the cytological diagnosis in 7 (63.6 per cent), a difference of 18 per cent in favor of our method.

The cytological examination has therefore a definite place in the study of the pathology of injuries to joints: it does not reveal the location or extent of a fracture, but it detects bone injuries beyond the limit of roentgenological technique. How the cytological study can help to solve difficult problems is illustrated by the following abstracts of 2 cases:

Case III. G. H., thirty-eight years old, injured on February 25, 1929; going downstairs, slipped and wrenched the left knee on the steps and abrased the left forearm. He was unconscious for a short time and walked with a limp after he got up. Over night pain and swelling increased in the knee. He was transferred the next day to the hospital.

History: An accident to the same knee happened a year ago: the patient slipped and bumped the left knee on the edge of a box. Knee was swollen and painful for about two months. He continued, however, to walk and work; was not under medical care.

Findings: The knee was swollen and very painful, limited motion, patella floating.

Aspiration of 80 c.c. of hemorrhagic fluid containing fat particles. It separated upon centrifugalizing in three layers; blood corpuscles at the bottom, 1 inch high; followed by a slightly cloudy hemorrhagic exudate; then a layer of solid fat on the top.

Roentgenogram showed a free piece of bone about 1 cm. long and ½ cm. wide in the joint space, possibly an avulsion from the femur, apparently not of recent origin. (See Fig. 5, lateral view.)

Cytological Diagnosis: Red and white blood cells, myelocytes, and numerous erythroblasts (See Fig. 2).

Therapy and Progress: Traction was applied

to knee for ten days, bivalved plaster cast the following fourteen days, later physiotherapy. Walked on crutches for two months. The leg at that time was still swollen and tender. Extension and flexion reduced.

Case iv. O. S., forty-six years of age: On February 2, 1929, a heavily loaded wheelbarrow fell over and the handle struck his left knee, throwing him to the ground. He wrenched his knee severely, was immediately disabled and transferred to the hospital.

Findings: Left knee very swollen and painful. Ecchymosis on outer side of the knee and upper third of the leg. Tenderness especially at the outer aspect of the knee. Previous injury to this joint denied.

Aspiration of 3 c.c. hemorrhagic fluid (small amount due to improper technique; centrifugalized in small tube and separated into three layers; ¼ inch blood corpuscles at bottom; 1¼ inch brownish, clear, limpid serum, and a layer of liquid fat on top.

Roentgenographic Examination: Fracture of the outer condyle of the tibia, involving the articular surface. Marked periosteal reaction, indicating eventually this fracture not being of recent origin (Fig. 6).

Cytological Findings: Red and white cells. Few synovial cells, and numerous erythroblasts (some microblasts and two macroblasts); some myelocytes.

Therapy and Progress: Hot compresses, cast for two weeks, later physiotherapy and massage. After two and one-half months knee still swollen. Flexion and extension reduced. Check-up roentgenograms show good consolidation.

The patient in Case iii had suffered an injury to the same knee joint a year before the recent trauma. He had pain and swelling for two weeks at that time, but was not under medical care; therefore no records are available to show the extent of the old injury. The free fragment of bone in the knee joint seen in our roentgen-ray films is well defined and therefore made the impression of an old fracture. But the demonstration of erythroblasts and myelocytes made the diagnosis of a recent injury to the bone positive. This was in accord with the clinical picture and the course of the injury. In the light of these findings we have to come to the conclusion that the fragment of bone in the roentgenogram was, despite its appearance, due to recent injury, or, if really caused by the previous trauma, there must be a recent lesion of the bone, which is not evident in our roentgen-ray films.

The roentgenograms in case four were also doubtful. Here a periostal reaction led to the suspicion of a somewhat older fracture. Again the findings of erythroblasts and myelocytes prove the presence of a recent bone injury; the clinical picture and the course of the injury support our diagnosis.

These 2 cases, as the rest of our material, are industrial accidents. The differential diagnosis had therefore an important bearing on the liability and compensation.

SUMMARY

1. Erythroblasts and myelocytes were demonstrated in the concentrated sediment of effusions in intra-articular fractures of the knee joints.

2. This method gives positive results even in minor injuries of articular surfaces (cracks or avulsions) which are not reproduced in roentgen-ray films.

3. This method is also of value to clarify a doubtful diagnosis.

4. By combining the method of demonstration of fat and elements of bone marrow in traumatic effusions, we worked out a differential diagnosis of the injuries to the knee joint: slight injury where fat is absent; severe injuries when fat is found; intra-articular fractures where elements of bone marrow are demonstrated in addition to the fat in the aspirated joint fluid.

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ELECTROTHERMIC SURGERY IN THE MANAGEMENT OF CARCINOMATA OF THE LIP*

J. THOMPSON STEVENS, M.D.

MONTCLAIR, N. J.

DURING the past six years the demand has increased rapidly for the treatment of premalignant and malignant lesions of the lip by electrothermic surgery. What are the reasons for this demand and for thorough preparation by physicians to carry out this particular operative procedure? To my mind there are at least three correct answers. One very important reason is the fact that the treatment can frequently be carried out satisfactorily without the patient having to give up his occupation for varying lengths of time. This is important in many instances, because the patient is free to earn his living and at the same time have the best of treatment carried out radically.

Secondly, the cosmetic results are second to no other surgical procedure. In the smaller lesions it is often difficult to find the site a few months after treatment, while in the larger lesions, where great destruction of tissue was indicated, those associated with us in the management of these cases are often dumfounded to see how little deformity follows the most radical operation. The ultimate result is without doubt the most important reason for so many of us advising this method of operating so enthusiastically. Surely no other method exceeds the results obtained by one skilled in the use of electrothermic surgery, and in not a few desperate cases the methods of treatment about to be described are the only ones that could be instituted even with a hope for success. In fact no less an authority on things surgical than Howard A. Kelly says:

I call it the new surgery; it is the biggest thing that has come into the surgical realm for many a year. We are using it every day and it is invaluable in some cases, either where radium fails or where the use of radium has so far altered the tissues that it is impossible to go ahead with it. One beauty of this form of treatment is that it can be so sharply and definitely localized, can be used repeatedly in the same area, and that the wounds consequently are generally not at all painful and healing is so beautiful.

IRRADIATION THERAPY

So that no false impressions may be created it is probably best to state that almost without exception every case of malignancy of the lip receives both preoperative and postoperative irradiation either with the roentgen rays or radium or both as indicated. The technique of this treatment has been stated in another paper[1] and cannot be repeated here for obvious reasons. These statements are made in full knowledge of the fact that some surgeons have objected to preoperative irradiation because of the delayed healing caused by such treatment. On the other hand the radiotherapist knows that this difficulty is due to the fact that too much time was allowed to pass between the preoperative irradiation and the operation, that the help to be obtained from the preoperative irradiation is realized *within a few hours after the treatments are completed and that no difficulty whatever will be encountered with*

[1] Stevens, J. T. Cancer of the lip; its treatment by coagulation, radium and the roentgen-ray. *Radiology*, May 1925.

* From the J. Thompson Stevens Clinic for Radiation Therapy and Electrothermic Surgery. Submitted for publication June 8, 1929.

wound repair if the cases are operated on promptly within forty-eight hours after preliminary preoperative irradiation.

procedure: surgical diathermy, fulgeration, surgical thermopenetration, desiccation, endothermy, endothermy knife and radio

FIG. 1.

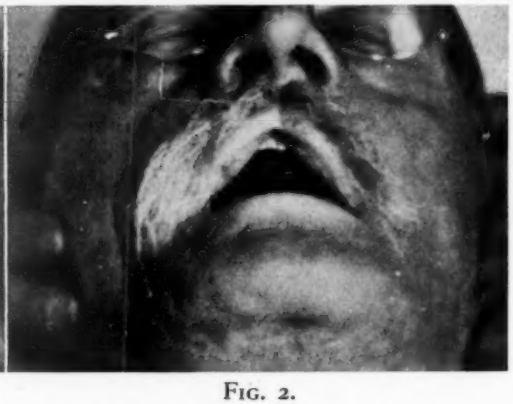


FIG. 2.

FIGS. 1 and 2. Only carcinoma of upper lip treated here during past fourteen years. It was of squamous cell type and patient has been perfectly well for over six years.

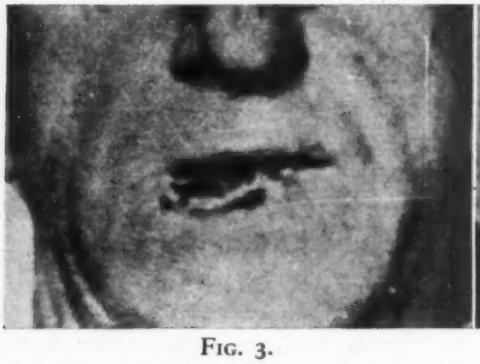


FIG. 3.

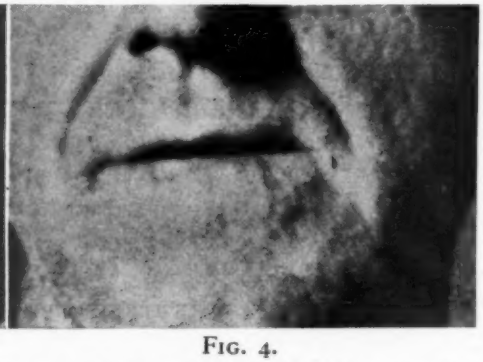


FIG. 4.

FIGS. 3 and 4. Squamous cell carcinoma of lower lip. Patient perfectly well for nearly nine years since treatment.

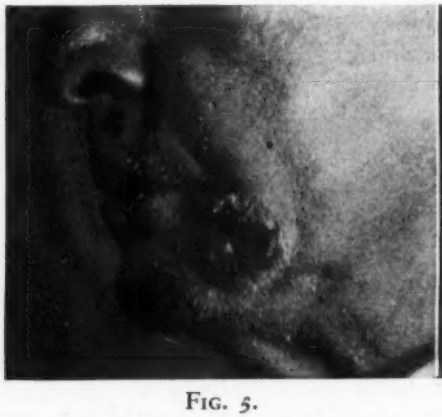


FIG. 5.

FIG. 6.

FIGS. 5 and 6. Squamous cell carcinoma of lower lip and left side of cheek. No signs or symptoms of disease have reappeared and patient has been well more than eight years.

ELECTROTHERMIC SURGERY

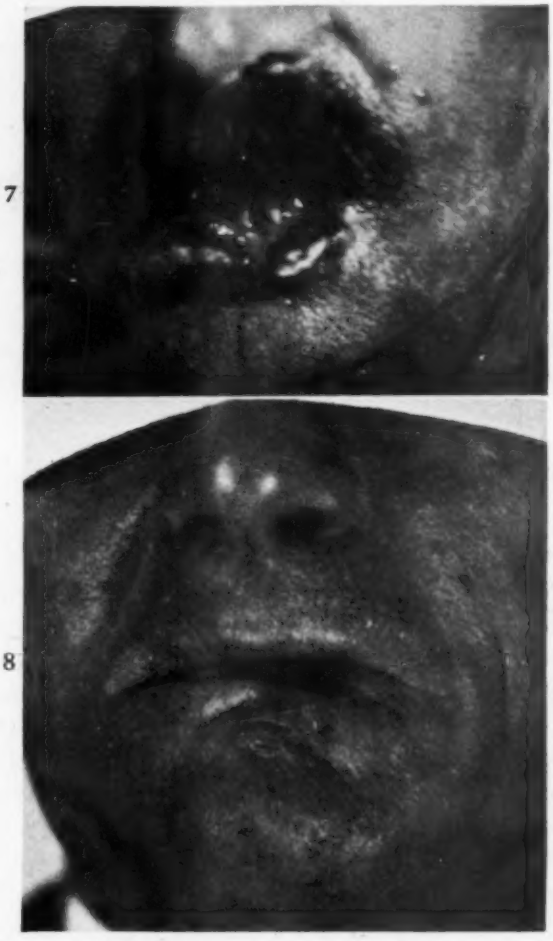
Unfortunately, as in other branches of medicine, we find here a multitude of terms used to designate one and the same knife. If we are to use the term endothermy it must be preceded by the word surgical, as is done when the term diathermy is used. To my mind there are some very

good reasons why all such terminology must eventually give way to "electrothermic desiccation" and "electrothermic coagulation," terms which at once convey to anyone's mind the fact that there is a production of heat by an electric current of sufficient intensity to desiccate or coagulate the tissues to which the current is applied.

By electrothermic surgical procedures from mild to intense heat is produced in the tissues operated upon by the many oscillations of a high frequency current which is applied by means of a pointed electrode. As compared with ordinary excision, it has the enormous advantage, in accessible cases, of *destroying the malignancy before it is removed.* It is the impossible to overestimate the value of this fact, that by electrothermic methods the growth is removed as a mass of dead tissue instead of a mass of viable cells. This, plus the fact that the lymphatics and blood vessels supplying the affected area are closed, tends to remove the possibility of mechanical metastasis. As compared with other methods of cauterization by heat, the active electrode is cold at all times. Heat develops in the tissues operated upon because of their resistance to the flow of the current. Therefore, it is progressively more penetrating the larger the amount of current used and the longer it is applied. The actual cautery rapidly heats the tissues to which it is applied to a very high temperature, the tissues being charred if the heat is applied long enough. However, the actual cautery does not produce sufficient heat deep down in the tissues and, therefore, the results in the treatment of premalignant and malignant lesions of the lip by means of the actual cautery fail to compare with those obtained by means of electrothermic surgery.

ELECTROTHERMIC DESICCATION TECHNIQUE

This is a surgical operation and, like most operations, to be most successful should be completed at one sitting. It is painful, and since there is danger of producing mechanical metastasis by injections of local anesthetics, it is the custom in my clinic to induce general anesthesia by gas-oxygen.



FIGS. 7 and 8. Squamous cell carcinoma of lip with deep involvement of lip. Patient also had syphilis which may have caused poor wound repair seen in this instance.

For the smaller malignant lesions together with the majority of premalignant lesions, the Oudin or monopolar current is used, the pointed electrode or applicator being held close to the tissue so that sparking occurs; the lesion is completely encircled with a necrotic, dried-out, or desiccated wall of proper depth, caused by the discharge of the sparks into the tissues. This desiccated wall must be placed in the healthy tissues at some distance from the actual lesion, this being the most important part of the operation and when properly done preventing metastasis.

If improperly performed, metastasis is almost sure to follow and failure to save the patient's life may result. The lesion itself is then completely desiccated by sparking as already described. If necessary, the needle may be run into the lesion, producing deeper desiccation. The desiccated tissues are next removed with a curet and if all of the unhealthy tissues have not been completely desiccated, further desiccation, not at some future time, but then and there at the first sitting, is indicated. If desired the operation can be completed by a dressing of collodion and cotton. This entire procedure has come to be known everywhere as the desiccation method of William L. Clark.

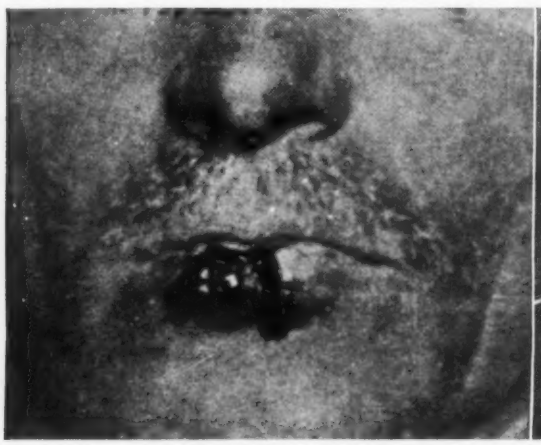


Fig. 9.

Fig. 10.

Figs. 9 and 10. Squamous cell carcinoma of lower lip. Patient well for nearly six years since treatment was completed.

ELECTROTHERMIC COAGULATION TECHNIQUE

For the larger malignant lesions and a few of the premalignant lesions which involve the tissues deeply, the d'Arsonval or bipolar current is used. With this current deep heat in any quantity indicated is obtained, allowing tissue of the body, including bone, to be easily destroyed. Therefore, in its use near bony structures care must be exercised to avoid their damage. Likewise, if the bones of a part are diseased, no operation can exceed it for efficiency in the destruction and removal of the affected bone. A large asbestos or metal electrode is connected with one pole of the high frequency machine, the electrode being generally placed in contact with the skin of the buttocks. This electrode must be well wet, preferably with saline, else the patient's skin may be burned. To the other pole of the machine the active electrode is attached. The point of the active electrode is then held in contact with the tissue to be destroyed and the current turned on, generally by a foot switch. Coagulation at one point is completed when the tissues are a dead white, or coagulated, and the current is switched off just before sparking begins. As already stated, the coagulation begins well out in the healthy tissues, the diseased area being walled off from the healthy tissues by a coagulation wall, and finally by painstaking care the carcinoma itself is destroyed and removed. All of the disease must be destroyed and removed at the one sitting, otherwise the patient's chances for ultimate recovery are jeopardized. A suitable dressing completes the operation.

ELECTRO-SURGICAL KNIFE

In operating with the electro-surgical knife a bipolar current is used, the arrangement of the electrodes being exactly as already described under electrothermic coagulation. The active electrode is usually only a solid needle the electric current generated in the tissues operated upon

actually causing them to separate as if cut by the sharpest scalpel. According to the quantity of heat generated, which can be perfectly regulated by the operator, the incised wound may be seared just enough to prevent capillary bleeding. Such a wound will heal promptly without difficulty in much the same manner as a clean, incised scalpel wound. If too much heat is used the edges of the wound become coagulated and prevent healing by first intention. When the larger vessels are cut across they are clamped and the electrode held in contact with the clamp until coagulation takes place. No ligatures have to be used and thus far no secondary hemorrhage has been seen.

RESULTS OF TREATMENTS ADVISED

In cases of carcinomata of the lip that are absolutely localized to the lip and that do not involve the lip deeply, i.e. cases that are called Group I in my clinic, give about 80 per cent recoveries for five years and longer. Cases that involve the lip deeply but have no evidence of metastasis, i.e. cases called Group II, give about 40 per cent recoveries for five years and longer. Cases in Group III, i.e. those with a primary lesion of the lip with metastasis into the neck, only show about 11 per cent recoveries for five years and longer. Cases in Group IV, i.e. those with primary lesions of the lip with metastasis into the neck and chest and with induration of the submental structures and cachexia, in a few instances show surprising palliations but no five year recoveries have been observed in this group.

CASE REPORTS

CONGENITAL ABSENCE OF KIDNEY*

SAUL J. PEARLMAN, M.D.

BROOKLYN

CONDITIONS of absence, atrophy and hypoplasia are likely to be confused in reporting cases of solitary kidney, and although the following cases might very well be classified as congenital absence, the reports lack the final proof inasmuch as the condition was recognized clinically.

Incidence. Piersol states that a solitary kidney occurs once in 2650 cases. Anders, in 1910, found an incidence of one to 1817 in 92,690 autopsies. Campbell, bringing the record up to date since 1910, for a total or 122,320 autopsies, reports an incidence of 1 in 1610 cases, which is rather a frequent occurrence. From a clinical point of view it makes very little difference whether a kidney is congenitally absent or destroyed by some secondary process.

Embryology. No other system in the body presents such peculiarities of development as the urogenital system. In the first place, it is exceedingly complicated on account of its many parts and is derived from both mesoderm and entoderm. In the second place, instead of one set of urinary organs developing and persisting, three sets develop at different stages. The first set (the pronephroi) disappears in part but leaves certain structures which are used in the development of the second. The second set (the mesonephroi) disappears for the most part leaving, however, some portions which are taken up in the development of the genital organs and other portions which persist as rudimentary structures in the adult. The third set (the metanephroi), or kidneys, develop in part from the second and are in part of independent origin. In the third place, the ducts of the genital organs are not homologous in the two sexes. The pronephroi in man have no functional significance but their ducts remain as the mesonephric ducts. The mesonephroi develop soon after the pronephroi as condensations of mesenchymal tissue in the region of the intermediate cell mass, forming secondary connections with the mesothelium at their inner ends and joining the pronephric ducts at their outer ends, the ducts now becoming the mesonephric or Wolffian ducts. Although the mesonephroi act as functional organs during the early stages of their development, they atrophy and disappear for the most part coincidently with the appearance and development of the kidneys. This degeneration begins during the sixth or seventh week and goes on rapidly until by the end of the fourth month little remains but the ducts and a few tubules. The metanephroi are the third set of urinary organs to develop. They assume the function of the mesonephroi as the latter atrophy, and constitute the permanent urinary apparatus. Each kidney is derived from two separate anlagen which unite secondarily. The epithelium of the ureter, renal pelvis, and straight renal tubules (collecting tubules) is derived from the mesonephric ducts by a process of evagination. The convoluted renal tubules and glomeruli are derived directly from condensations of the mesenchyme, which make up the so-called metanephric blastema or nephrogenic tissue. It is this tissue which is destined to give rise to the convoluted tubules and glomeruli. Thus

* From the Department of Urology, Brownsville & East New York Hospital. Submitted for publication April 9, 1929.

unilateral renal agenesia would be explained by a failure of development of the two renal anlagen on the affected side.

Fig. 1.

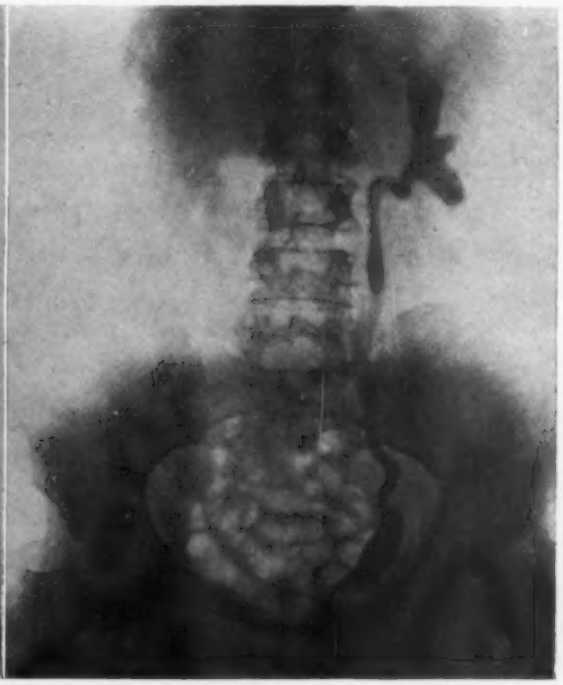


Fig. 2.

Failure of the Wolffian duct to give off its bud would result in a deficient ureter and pelvis with presence of kidney tissue on the same side. Should, however, the ureteral bud go on to complete development with a failure of development in the metanephric blastema the resultant condition would be a persistent ureter and absence of kidney tissue above on the affected side.

Condition of the Existing Kidney. When one kidney fails to develop (aplasia, agenesis) or is abnormal from associated defects, or develops imperfectly (hypoplasia) and the opposite renal anlage and developing tissue are normal, the latter compensates for the respective loss. This compensation has been found to be due to a hyperplasia rather than a hypertrophy of the glomeruli and tubules. In the cases that may be regarded as true solitary types and in which careful measurement has been made, the single kidney has weighed and measured the same as that of two normal kidneys of a similar individual (Rager, Gruber and Bing). Hinman states that there is no reason, or proof to the contrary to believe that a solitary kidney, of congenital origin, is not the equal of two kidneys both anatomically and functionally. The individual with a solitary kidney, however, lacks the renal insurance of a normal person.

Occurrence of Disease in the Existing Kidney. That the single kidney is more apt to be the seat of pathology is fairly well admitted by the majority of writers. Fortune, from a collected series of 422 autopsied cases of congenital absence of one kidney, reports kidney disease as being present in 22.6 per cent as against 15 per cent in an average run of autopsies. Anuria, pyuria, hematuria, and frequency of urination are the chief symptoms which direct attention to the urinary tract and thus enable the urologist in the majority of instances to establish the clinical diagnosis.

Presence or Absence of Ureter. The finding of two ureter orifices on cystoscopic examination is not sufficient to rule out the presence of a single kidney because in many instances the ureter on the

deficient side persists. Fortune in 54 per cent of his series noted the ureter as being absent, and present in 42 or 10 per

Fig. 3.

cent. Urine and dye appearing from both orifices is a clear-cut indication of the presence of two kidneys. Occasionally unilateral crossed ectopia with renal fusion occurs. This may show two ureter orifices and an absence of a kidney shadow on the roentgenogram. In this instance the position of the shadowgraph catheters and pyelography would reveal the anomaly.

Presence of Associated Defects. Inasmuch as the uriniferous system is closely related to the reproductive system, defects in the latter are often associated with defects in the former on the same side. The finding, therefore, of congenital anomalies in the genital system should immediately guard one against the presence of associated defects in the urinary system and should call for a complete urological survey. Thus, Campbell reports finding a unicorn uterus with rudimentary ovary and Fallopian tube in two instances. Others have noted the complete absence on the same side of prostate, epididymis, vas deferens, seminal vesicle and ejaculatory duct. In the female, the uterus has been found absent and vaginal anomalies have been present.

CASE REPORTS

Case 1. Male adult, aged forty-three, admitted to the medical service of the Brownsville and East New York Hospital on Februray 27, 1928 complaining of multiple joint pains, and because of the presence of a pyuria was subjected to a urological survey. Urinalysis showed many pus cells in clumps, many hyaline and granular cases. Culture was positive for Bacillus coli. Total phenolsulphonephthalein output was 43 per cent for two hours. The kidney concentration ranged between 1006 and 1011. The blood pressure was 118 systolic, 70 diastolic. The urea nitrogen was 87.50 mg. per 100 c.c. of blood. A plain roentgenogram of the urinary tract revealed an absence of a left kidney shadow. The right kidney shadow was larger than normal. Cystoscopy failed to reveal a left ureter orifice, no dimpling. Indigo carmine, intravenously, made its apperance within three minutes from the right ureter mouth with a good concentration. A No. 6 F. shadowgraph catheter passed easily to the right pelvis. No retention or obstruction was encountered. The urinary efflux was hazy and showed many pus cells microscopically, the culture being positive for B. coli. Cystoscopy was repeated and after plugging the right ureter mouth with a No. 12 F. Garceau catheter and indigo carmine administered intravenously, no blue was seen to enter the bladder, urethra or rectum. A pyeloureterogram revealed a slight dilatation of the right kidney pelvis with slight blunting of the terminal calyces and the right ureter somewhat dilated. The urea nitrogen after three weeks stay in the hospital dropped from 87.5 to 17.6 mg. per 100 c.c. of blood.

Diagnosis. B. coli pyelonephritis in a single kidney.

Case 11. A female, aged forty-nine, admitted to the urological service on March 22, 1928 complaining of frequency of urination and pain in the left lumbar region. A catheter specimen of urine showed many pus cells. A plain roentgenogram of the urinary tract revealed an absence of the right kidney shadow. Cystoscopy: The bladder efflux clear,

containing numerous pus cells in clumps. There was a polypoid edema of the vesical sphincter. There was an absence of the right ureter orifice. A No. 5 F. shadowgraph catheter passed to the left pelvis and 12 c.c. of retained urine were aspirated which showed a few leucocytes on microscopy. The cultures were negative for B. coli and tubercle bacillus. Indigo carmine, injected intravenously, made its appearance from the left orifice in five minutes, deeply concentrated. Cystoscopy was repeated. A Garceau catheter plugged the lower end of the left ureter and a pyeloureterogram was obtained. This showed a moderate hydronephrosis, a dilatation, angulation and stricture of the ureter. On a subsequent cystoscopy a catheter was passed to the left pelvis and a urethral catheter inserted into the bladder. No blue was seen to enter the bladder, urethra, vagina or rectum.

Surgery of the Existing Kidney. The surgeon who wilfully performs nephrectomy, no matter how urgent the case may be, without determining the presence and condition of the opposite kidney is guilty of gross neglect. The literature contains records of about 20 unfortunate instances of nephrectomy being performed on a single kidney. In Fortune's collected series of 422 cases there were 10 deaths following removal of the single kidney and also 6 deaths following other operations on the kidney. These facts indicate that operations on the single kidney are fraught with risk and should be undertaken only when palliative measures have failed to obtain relief. There are several instances, however, of cases of complete anuria due to ureter blockade of a single kidney that have been successfully treated surgically. In this connection, I wish to cite the following case:

Case III. L. F., male adult, aged thirty-six, admitted on March 2, 1926 to the Urological Service of the Brownsville and East New York Hospital with an anuria of twenty-four hours' duration. His history revealed the fact that he had had bilateral kidney calculi and had been nephrotomized on both sides three years prior to admission, subsequently being subjected to a left nephrectomy. Urological examination on admission revealed the anuria as being due to a large ureter calculus impacted at 8 cm. from the right ureter mouth. In addition there was a large calculus, collar-button in shape and filling the entire pelvis with an infected hydronephrosis, and a group of several smaller calculi in the region of the lower pole of the remaining kidney. A No. 5 F. shadowgraph catheter was successful in overcoming the obstruction and relieving the blockade. The catheter was left in situ and pelvic lavage instituted. The catheter was removed at the end of four days. Several attempts to remove the ureter calculus by ureteral manipulation were unsuccessful. With a phenolsulphonephthalein of 35 per cent for two hours and a blood urea nitrogen of 24 mg. per 100 c.c. it was decided to resort to surgery.

On March 23, 1926 a combined extraperitoneal ureterotomy and cystostomy was performed the calculus being forcibly milked into the bladder and removed. The patient left the hospital twenty-four days postoperatively with clear urine containing microscopic pus and a urea nitrogen of 11.5 mg. per 100 c.c.

SUMMARY

1. Unilateral agenesia occurs once in approximately 1600 individuals, 2 case reports diagnosed clinically are added to the literature.

2. The condition is frequently encountered by the urologist because of the frequency of disease in the existing kidney.

3. Surgery of the existing kidney is extremely hazardous and only the most palliative measures should be employed.

Note: I am indebted to Dr. Paul W. Aschner, Chief of the Urological Service, for permission to use the clinical material presented.

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SOLITARY CYSTIC FIBROMA OF THE CAUDA EQUINA, CALCIFICATION OF INTERVER TEBRAL DISC, AND CONGENITAL MALFORMATION OF VERTEBRA*

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THE following case is of interest for the reason that it presents a combination of unusual features:

A. F. M., Male, white, aged 40, was first seen November 19, 1927. He complained of a paralysis of both legs, which he attributed to an attack of influenza in 1918. At that time he was in bed for about a week and after recovery, the paralysis was noticed. This had been gradually progressive since onset, especially in the right leg, although he had always been able to walk without support. He had been employed as a fireman for a railroad, but was forced to discontinue this work on account of his disability. He had no injury or other illness to account for his condition. The progress in the paralysis was most noticeable each year during the spring. The hips and knees felt somewhat weakened.

The past history revealed that at the age of twelve years he had had "rheumatism" in his back, with severe pain in the lower back, radiating down his thighs posteriorly. This continued for about six or seven years. During this time there was no joint involvement elsewhere.

At the age of twenty-three he began to have difficulty in emptying his bladder, and at times for several days had rather severe cramping pain in his lower abdomen. This condition was mildly progressive until he was about twenty-eight years old, when it became so marked that he could void only a small amount of urine at a time, and had more or less continuous pain due to distention. At that time he began to catheterize himself, and he has done that once a day ever since. The amount of urine obtained at catheterization was usually about 1 pint. Several years after the onset of urinary trouble, he became constipated and for the last five years he has taken an enema daily. There was no history of venereal disease.

In regard to his paralytic condition he stated that on several different occasions, before his attack of influenza, he noticed that his ankles were somewhat weakened, though he never had any serious disability. Additional information from his sister indicated that he always had had weakness of his lower extremities, even during childhood.

There was no history of any similar condition among his relatives.

Examination revealed no abnormalities of the upper extremities.

The spine showed normal muscle power and normal mobility. No deformity or tenderness was noted. Over the first sacral segment in the midline was a round area of pigmentation about 2 cm. in diameter and in the center of this area was a small pit about 3 mm. wide and confined to the skin.

Muscle power in the hips was practically normal and there was no isolated paralysis.

In the left thigh, a definite weakness of the biceps femoris was present.

The legs and feet felt cold to the touch; no trophic changes were seen. In the standing position a valgus deformity was present in both feet. The gait was slow and unsteady. In neither foot was there any deformity due to contracture of muscles or ligaments. In the left leg the tibialis anterior was normal and the tibialis posterior was active but very much weakened. No other movements were possible. In the right leg plantar flexion was present but very weak. Otherwise paralysis was complete.

The patellar reflex was present on left, absent on right. No plantar response was obtained.

Sensory disturbances consisted of a saddle anesthesia and a marked diminution of sensation on the lateral border of the right foot.

Spinal fluid examination showed a xanthochromia and many red-blood cells; globulin ++; Wassermann reaction negative; four cells per cubic millimeter.

*Submitted for publication June 18, 1929.

Roentgen rays of the spine showed in the anterposterior view several small shadows under the spinous processes of the second and

Fig. 1. Roentgenogram of lumbar spine, L. I., first lumbar vertebra. Note area of calcification between bodies of first and second lumbar vertebrae; also area of rarefaction in posterior portion of body of second lumbar vertebra.

third lumbar vertebrae; these were located stereoscopically as being inside the spinal canal. In the lateral view (Fig. 1) an incomplete calcification of the intervertebral disc between the first and second lumbar vertebrae was found, also an area of rarefaction of the posterior third of the body of the second lumbar vertebra. This was interpreted as a destructive process, which appeared to extend posteriorly into the canal.

A diagnosis was made of compression of the cauda equina, at the level of the second lumbar vertebra.

Exploratory laminectomy was performed March 28, 1928. After removing the laminae of the second and third lumbar vertebrae, the dural sac was found to be very much distended, filling out the entire spinal canal. No pulsation was noted. At the level of the second lumbar vertebra, no flattening of the dural sac was seen, such as would be expected from the Roentgen-Ray appearance. The bony relations of the vertebral column seemed normal. The distention of the dural sac was uniform. Through a small opening in the sac a small piece of tissue was obtained which looked grossly very much like fat tissue. No

Fig. 2. Portion of wall. Hyaline transformation and calcification of matrix.

microscopic examination was made. Only a very small amount of spinal fluid escaped from the opening. The pathological process seemed to extend for a considerable distance in both directions and appeared beyond immediate relief, except for such benefit as might be obtained by decompression. The incision was closed in layers.

Recovery was uneventful except for a mild skin infection, which healed promptly.

The condition remained practically unchanged. The patient was seen at frequent intervals and at times felt that his legs were somewhat stronger.

Further observation indicated that the lesion responsible for his condition was probably situated at a lower level than the one which had been explored. The findings at operation revealed normal bony relations and the roentgen-ray appearance of the second

lumbar vertebra, in the absence of any definite symptoms attributable to it, seemed to be best explained as a congenital defect, not related to the rest of the clinical picture. The distention of the dural sac at that level was not considered to be the sole cause of the disability, or certainly it would show more pronounced impairment, referable to involvement at a higher level. Accordingly another operation was undertaken.

Fig. 3. Metaplastic bone in wall. Typical lamellae, bone cells and bone marrow.

Operation, September 7, 1928: Laminectomy of the fourth and fifth lumbar vertebrae. After removing these laminae, the dural sac was found to be approximately normal in appearance. At the level of the lamina of the fourth lumbar vertebra, a nodular mass was felt inside the dural space. The membranes were incised longitudinally, and a small amount of yellowish spinal fluid escaped. The nerves of the cauda equina were situated laterally, and among them an elongated mass of hard tissue was found at the level of the fourth lumbar lamina. This was about 2½ cm. long and 1 cm. in diameter. It was somewhat movable, being attached superiorly and anteriorly to the meninges by fibrous bands. The mass was bony in consistency and the lower end was bluntly tapered. It was partly covered by the roots of the cauda equina, although none of the nerves was adherent to it. A few of the nerves showed a distinctly bluish color, but most of them appeared to be normal. At the lower end of the mass was a small, yellowish, spindle-shaped structure about 5 mm. long and 3 mm. wide. This was attached to the larger mass by a narrow pedicle. During manipulation the larger mass was broken and inside a thin bony shell was a small amount of necrotic tissue. Both structures were removed. After suturing the membranes the incision was closed.

Fig. 4. Section through distal process of tumor. Cyst wall consists of fibrous tissue. Interior of tumor is composed of amorphous material without cells.

Following is the pathological report by Dr. C. Alexander Hellwig, pathologist at St. Francis Hospital:

Macroscopic Findings: Four irregular flat fragments composing the wall of the cystic

tumor. The largest of these measures 10 by 14 mm. and is 3 mm. thick. Two of the fragments are very hard, of bone-like consistency; the other two represent dense fibrous tissue. The external surface is smooth, the internal ragged. The distal process of the tumor is spindle-shaped, 4 by 3 mm., and has a glossy gray surface; its consistency is elastic.

In fresh smears of the viscous gray contents of the cyst, no cellular elements can be recognized; neither are any crystals (cholesterin) present. There are only thick fibers and amorphous material which does not give a positive fat reaction with Sudan III.

Microscopic Findings. Sections from the wall of the principal tumor show fibrous tissue with few fibrocytes and scanty blood vessels. In several portions hyaline changes of the collagen fibers, extensive calcification and typical bone trabeculae, with bone cells, regular lamellae and bone marrow can be seen (Figs. 2 and 3).

Sections through the spindle-shaped process (Fig. 4) reveal a very thin fibrous capsule with few fibrocytes, and which surrounds necrotic eosine-stained material. No distinct texture of this central mass can be made out, but only thick fibers which enclose spaces filled with amorphous material.

Serial section of the cystic tumor failed to show any ectodermal or entodermal elements and therefore we have to exclude a diagnosis of teratoma. We searched carefully for nerve fibers in the tumor but were not able to demonstrate these either, which would exclude the diagnosis of neurofibroma.

The bone trabeculae are found, in our tumor, only near areas with hyaline transformation and calcification of the fibrous matrix. We feel justified therefore in regarding the tumor as a fibroma which is partially converted into bone by metaplasia. The central necrosis and liquefaction, which are easily explained by the poor blood supply, are the causes of the cystic appearance of the formerly solid tumor.

Pathological Diagnosis. Cystic fibroma with ossification.

Solitary fibromata of the cord according to Ewing[1] are probably in most cases hard neurofibromata. While usually appearing as small hard masses, attached to dura or pia, they are occasionally cystic, and at times rather cellular and vascular.

Schlesinger[2] found, among 35,000 patients admitted to the Wiener Allegemeinen Krankenhaus, 6540 cases of tumor, and of these 151 were located in the spinal cord or the spinal meninges. Among this material only 2 cases of solitary fibroma of the cord or its coverings were found. Schlesinger, however, was able to collect from the literature 15 cases of solitary fibroma of these structures. Of the 15 cases, 5 were extradural, and 10 were intradural. Of the intradural fibromata, 7 had their origin from the meninges and 3 from the nerve roots. The exact site of origin was not known in most instances, although in 2 cases the tumor arose from the meninges anteriorly. There was no predilection for any certain level.

Schlesinger states that the solitary fibroma (and neurofibroma) has its origin, as a rule, in the coverings of the spinal cord, especially in the dura mater. It presents a circumscribed tumor of moderate size, firm consistency and dense fibrous structure. Only occasionally do hemorrhage and softening occur with formation of cystic cavities in the tumor. Transitions to other forms of tumors (myxoma, sarcoma, neuroma) are relatively frequent. Pure fibromata are characterized by very slow growth, mixed forms develop more rapidly.

Calcification of the intervertebral disc, also called "calcinosis intervertebralis" by several writers, has been known only in recent years, the latest contribution being that of Rietema and Keijser.[3] Their patient a man, aged fifty-two, complained of pain in his left leg for a period of eight months. Rigidity of the spine with marked tenderness of the twelfth dorsal vertebra were noted. Roentgen-ray examination revealed a calcification of the intervertebral disc between tenth and eleventh dorsal vertebrae.

In another case reported by these authors pain had been present for years in the lumbar spine. The lower dorsal and upper lumbar vertebrae were tender to pressure. The roentgen-ray examination

showed a calcification of the disc between the eighth and ninth dorsal vertebrae.

Calve and Galland[4] found a calcified intervertebral disc in a seventy-two year old man, who complained of pain in his left shoulder.

Horenstein's[5] patient, a man forty years old, had a painful stiff back for twelve years. The lower dorsal vertebrae were tender to pressure, and the roentgen-ray examination revealed a calcified area, between the eleventh and twelfth dorsal vertebrae.

Lusskin[6] found a calcified intervertebral disc between the tenth and eleventh dorsal vertebrae, in a man fifty years old, who was suffering from a low back pain and a partial paralysis of the right lower extremity. The lesion was discovered incidentally and had no bearing on the rest of the clinical picture.

Baron[7] noted a calcification of the discs between the twelfth dorsal and first lumbar, and the first and second lumbar vertebrae. The patient was a child twelve years old with an infectious condition, and the spinal lesions were discovered on the eighteenth day of the illness. The explanation for the occurrence of this finding was that it probably resulted from a localized inflammation in an area, generally considered as a locus minoris resistentiae.

Barsony and Polgar[8] reported a case of multiple areas of calcification, involving the discs between the seventh and eighth, eighth and ninth, and ninth and tenth dorsal vertebrae. The lesions were discovered incidentally while examining the patient for doudenal ulcer. The patient, a man forty-seven years old, had had an injury to his spine twenty-six years previously, and the calcification was, in their opinion, undoubtedly of traumatic origin. It is also stated in their report that subsequent observation of Baron's case revealed a disappearance of the calcified area.

It is interesting to note that Schmorl[9] in a recent report makes no mention of this lesion, although his material consisted of about 2000 spines examined for effects of trauma to the intervertebral cartilages. As yet there is no record of any pathological study made on this condition and the pathogenesis is obscure, except for the information obtained from roentgenographic study. Calve and Calland and Horenstein believed that the lesion had its origin in the nucleus pulposus, where the remains of the chorda dorsalis are found. Rietema and Keijser disagree with this view, for the reason that the calcified lesion is located in front of the central point of the disc. The illustrations in Baron's case suggest that the process does have its origin in the nucleus pulposus. In the case of Barsony and Polgar there are several small islands of calcification giving rise to the belief that the lesion may originate in different portions of the disc.

In regard to the symptoms produced, it would be difficult in most instances to attribute them to this lesion. Most outstanding in this respect are pain and tenderness, but these are usually not sufficiently close to the pathological area to warrant association of the two features. Likewise in the greater number of cases, the symptoms disappeared under treatment although the pathology remained. In the case here reported, there was no indication that the process was in any way related to the symptoms.

GENESIS OF CYSTIC FIBROMA

In the case under discussion the cystic degeneration and ossification are undoubtedly secondary processes. The etiology of fibromata is obscure, yet it is generally accepted that they are embryonic in origin, being brought about by displacement of fetal remnants during intrauterine life. However, the exact mechanism by which such displacement occurs is not clear.

From the nature of the tumor here described and perhaps other, more complex lesions, it seems probable that they may be explained by a process similar to that observed by Hertwig,[11] on the effects of radium irradiation on the early develop-

ment of frog's ova. This investigator noted that the products of irradiated germ cells and fertilized ova were abnormal, very often presenting extensive malformations. From the microscopic examination of embryonic forms he noted what he termed "radium disease:"

Individual cells* which were damaged more than others separate themselves from their connections with the more viable cells and are extruded to the exterior or into body cavities (germinal vesicles, central canal of cord, brain ventricles, peritoneal cavity, intestinal canal, auditory vesicle.) These cells come together in a round mass, and persist for variable periods of time before they die or disintegrate . . . The cells which are less damaged retain their connections, can multiply, wander into organs, and continue to differentiate histologically.

On this assumption it would be necessary to find a cause for the occurrence of this lesion analogous to the radium exposure used by Hertwig. It will be recalled that Hertwig has produced a number of monstrosities of varying degrees of severity. It is now generally known that roentgen-ray and radium irradiation are capable of producing gross abnormalities in man, although such effects can be excluded in most instances. In a recent analysis[11] of a small series of cases, a suggestive etiologic relationship was noted between congenital anomalies and ultraviolet light. In this respect we may perhaps assume a similarity of biologic action between roentgen rays or radium and ultraviolet rays. The extent to which such effects are responsible for congenital malformation and other lesions must be determined by further study. It seems not unreasonable that a large variety of abnormalities may owe their origin to primary germ defects or injury to the fertilized ovum in its early stages, and brought about by some phenomenon as Hertwig described. Among the various agents which are capable of producing alterations of the germ plasm or of the fertilized ovum, the possibility of ultraviolet light is worthy of consideration. At any rate, the pathological picture presented in this case seems to be adequately explained by an embryologic disturbance similar to that observed by Hertwig, and our knowledge of the mechanism of production of such disturbances must depend on further investigation.

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*These cells were designated by Hertwig as *ausgestossene Zellen.*

OVARIAN HEADACHE*

MAURICE KAHN, M.D., F.A.C.S.

LOS ANGELES

THAT pelvic disease may cause headache has been known for years; in fact, at one time during the heyday of gynecology as a specialty it was hardly safe for a woman with headache who valued her pelvic organs to venture into a gynecologist's office. The typical case of headache resulting from pelvic disorder is not difficult of diagnosis, is not especially interesting, and the symptoms certainly need not be gone into at this time. They are well understood.

The case I am here reporting presented a rare symptomatology and proved interesting because I was unable to explain one peculiarity. I hope to find an explanation of this feature of the case which the literature does not provide.

In May, 1920, I was consulted by a woman of thirty-eight, married fifteen years, the mother of three children, complaining of severe headaches which began at the age of eighteen. She said she had very few days without some headache but it would be severe about once a week. At one time she was in bed for ten days. This was her most prolonged attack. The pain always started at the base of the neck on the right side and extended upward and forward over the top of the head and about the right eye. Her attacks of pain always began on awakening in the morning, and whereas she might have a good night's sleep and go to bed without any pain whatever, and was never awakened during the night by pain, yet it would begin soon after awakening in the morning. During the twenty years of headaches she had sought relief in numerous medical centers in this country and in Europe where she consulted internists, gynecologists, neurologists, rhinologists, ophthalmologists, etc. As she expressed it, she had been everywhere, seen everybody, and undergone every test imaginable; and she still had her headaches which were getting more severe. She thought she had a brain tumor and wished me to open her skull and search for it. I mention this merely to indicate her desperation. In 1914 she was curetted for her headaches but it gave no relief. Catamenia was regular, twenty-eight day periods, flowed four or five days, eight to ten napkins in all. Never dysmenorrhea. No leucorrhea. She would usually have a headache after her period. Never any illness except childbearing. No stomach symptoms. Bowel movement daily and regular. Examination failed to reveal to me the cause of her complaint. Aside from a blood pressure of 160-110 and a very slightly enlarged uterus in good position with a tiny fibroid low on its posterior surface, everything was normal. Wassermann test was negative.

I sent her in turn to a rhinologist, oculist, and internist, and all reported that they were unable to find a cause for her complaint. She left the city for the summer soon after this time, and I did not see her again until the following October. Not knowing what else to do I suggested that she have a physician experiment with the various endocrine gland extracts, which she did. This too was a failure. In April, 1921, during one of the consultations, she happend to mention that during the three pregnancies she was free from headaches, but they returned with great intensity promptly after delivery. Here was a real clue to our problem, but what was the solution? (1) Was some secretion present during pregnancy that neutralized a headache-producing toxin? (2) Did pregnancy inhibit some headache producing secretion? (3) Did pregnancy stimulate some secretion which in her case was deficient in the non-pregnant state? (4) Did the condition of the uterus act reflexly on the ovaries causing a disfunction of their secretion resulting in an imbalance of the various internal secretions, and thus cause headache? Or (5) is there an internal secretion of the uterus? And if so, did the thickened wall of the uterus and the thickened endometrium alter this secretion so that it in some manner caused headache which the increased vascularity incident to pregnancy normalized? She was again out of town for several months and my next notation is November 1, 1921.

* Read before the Western Surgical Association, Chicago, Dec. 15, 1928.

For the following five months I experimented with various procedures: applications of different kinds to vagina, cervix, and cervical canal, dilatation of cervix and intrauterine instrumentation. Accurate record was kept of what was done and the patient's report of after-treatment symptoms recorded. During these five months the patient was kept in ignorance of what was actually performed. The setup of the treatment table was always the same; the instruments were clicked about the same amount whether I dilated the cervix, passed a sound into the uterus or merely touched the cervix with cotton moistened with plain water. This was done of course to prevent being misled by the patient who might think one form of treatment was more likely or less likely either to cause or prevent a headache. I went further: In order to confuse the patient, I would on one occasion tell her I expected her to be better and on another, performing the same procedure, express the opinion that she would be worse. This was done to guard against misinformation being given me, having in mind a fact with which we are all familiar, viz., that some patients are prone to tell a doctor what they think he wishes or expects to hear. To avoid becoming tedious I shall not go into further details of this little experiment but merely record the illuminating result. I found that 20 per cent silver nitrate applied to the endocervix, or considerable irritation of the endometrium with a uterine sound, would cause headache; and toward the end of the investigation I found that I could precipitate a headache at will.

Feeling that I had located the source of her headaches I felt justified in advising panhysterectomy. The patient and her husband acceded with enthusiasm to this suggestion. So in April, 1922, I performed panhysterectomy and double salpingo-oophorectomy. She had two severe attacks of headache during the month following the operation. She has had none since.

Pathologist's Report. Uterus is moderately enlarged, wall is thick. The cervix is irregular from old lacerations and is firm from fibrous tissue. The epithelium, however, shows no ulceration or thickening. In the cervix is found a small encapsulated fibromyoma. Beneath the serosa at the fundus is another. The endometrium is rather thick but shows no evidence of new growth. Tubes are thin. Ovaries contain small cysts. Diagnosis: Old lacerations of cervix. Small myomata of uterus. Follicular cysts of ovaries.

In April, 1927, I performed a subtotal thyroidectomy for hyperthyroidism.

It is the consensus that the corpus luteum is the seat of the internal secretion of the ovary. No corpus luteum is formed during pregnancy, hence there is a diminution of the internal secretion during this period. Headaches were absent during pregnancy when the internal secretion was greatly reduced, and also after operation when the patient was deprived of all ovarian secretion. Therefore it seems probable that the internal secretion of the ovary in some manner caused the headaches.

MULTIPLE HYDATIC CYST OF LIVER*

Rea Smith, M.D.

LOS ANGELES

I HAVE for discussion a case of multiple hydatid cyst of the liver, apparently developed in our own community.

The patient, a man of thirty-eight years, of Jewish nationality, with occupation of fruit peddler, was sent to me on June 21, 1928, with a tentative diagnosis of carcinoma of the liver. He complained of dull pain and distress in the right hypochondrium, feeling of fullness in the abdomen, and constipation. He had had a diagnosis of gall-bladder disease at various times during the last eight years. The patient was well nourished, good color,

* Read before the Pacific Coast Surgical Association, Santa Barbara, February, 22, 1929.

with a huge palpable liver extending to the crest of the ilium, edges smooth. A diagnosis of benign liver tumor, probably an echinococcus

Fig. 1. Appearance of cysts in liver when abdomen was opened

cyst, was made largely upon the absence of consitutional symptoms to correspond with the physical findings. He had at this time 5,088,000 red blood cells; 88 per cent hemaglobin; 12,500 leucocytes, 65 per cent polymorphomiclear and 6 per cent eosinophile.

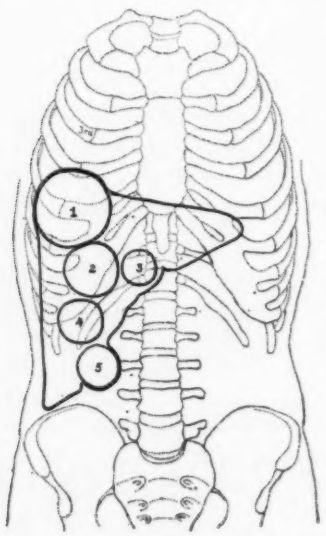

Fig. 2. Diagramatic drawing of cysts in liver, showing relative size.

He was operated upon May 25, 1928, at which time five cystic tymors were palpated, three being in the upper part of the right lobe, one in the center, and one in the lower portion of the right lobe underneath the gall bladder, pushing it off the liver for a distance of several inches. The field was protected with packs, the liver incised over the cysts and the cysts removed. The one uppermost in the right lobe was removed through the septum of the liver tissue from the cavity of the cyst imme-

Fig. 3. Diagramatic drawing showing cyst in fat of ischiorectal fossa with exposure by incision over sacrum and coccyx.

diately beneath it. The cyst walls were friable and each contained a clear fluid. The cavity in the liver was packed tightly with gauze, although there was not enough liver hemorrhage in any except the upper cavity to necessitate it.

The patient had rather a stormy convalescence on account of suppuration after the

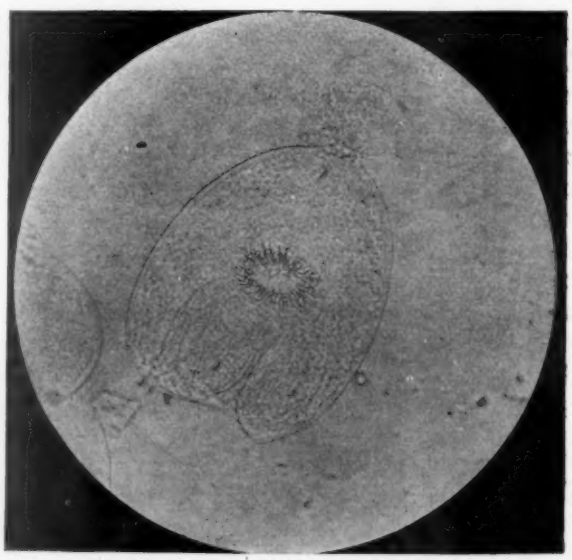

Fig. 4. Scolex from wall of cyst showing hooklets.

removal of the guaze, but made a good recovery and was discharged from the Hospital on August 7. The laboratory demonstrated live scoleces of the echinococcus in the walls of the cyst and none in the fluid.

The echinococcus is a small tapeworm, which develops in the intestinal tract of the dog, wolf, fox and jackall. Man is

the intermediary host; the tape worm does not develop in the intestinal tract of man. The echinococcus is ¼ inch in length when full grown, consists of four segments, the terminal segment being the egg sack contains about 500 ova. This ova contaminates drinking water, vegetables and fruit on the ground. The ova is injested by man, finds its way, usually to the liver, or lungs, and in the larvae form the head only develops, having a pointed rostellum. In the center of the head are well-marked sucking cups and the rostellum is surrounded by a double row of hooklets, numbering between thirty and forty. Scolices develop in the brain and meninges rarely, usually in cysts or abscesses in the lungs, liver or kidneys. The fluid of the living cyst contains no albumen, no hooklets and is not capable of producing toxic effect if injected into animals. If a cyst is dead, the fluid becomes toxic and the patient may suffer a sudden collapse if the cyst ruptures and the fluid enters the peritoneal cavity. This disease is common geographically where there is a close relationship between humans and dogs, as, for instance, Iceland, Australia, Algiers, and the Argentine. It is rarely found in North America, and when found, the patient is usually a foreigner.

This patient attributes his infection to the eating of raw pork while in the army in 1918, from which time he dates his symptoms of liver trouble and constipation. However, his occupation of fruit peddler seems to me to be a possible source of infection.

The patient returned to me on January 8, 1929 complaining of increasing constipation and tenesmus. Rectal examination disclosed a

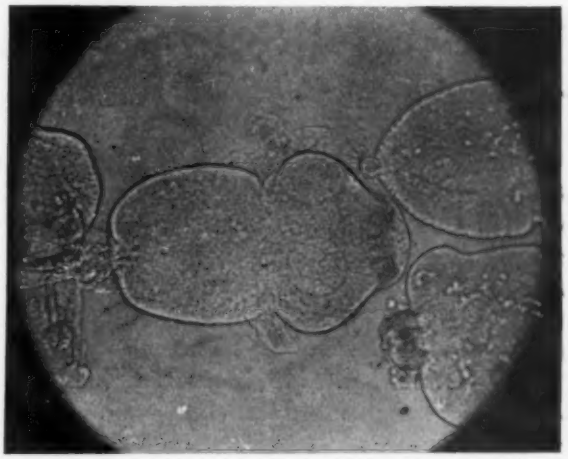

Fig. 5. Scoleces from wall of cyst.

firm elastic round tumor, lying in the left ischiorectal fossa. Cystoscopic examination ruled out bladder and prostate as the seat of the tumor. In view of the patients history a diagnosis of echinococcus cyst in this region was not difficult, although the site was most unusual.

January 11, 1929, under spial anesthesia, the patient was put in the reverse Trendelenburg position, and an incision over the sacrum and coccyx, such as would be used in a Krasky operation was made. Muscles were separated from the coccyx and retracted, the pearly white cyst wall presented. It was removed with ease, the cavity flushed with mercurochrome and packed. The cavity healed by first intention, and the patient left the Hospital on January 27. His second cyst was of the same size as those removed from his liver, was alive, and apparently had been there since his original infection. The troublesome constipation has entirely disappeared.

TUBERCULOUS STRICTURE OF THE URETHRA*

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THE patient, a man of twenty-nine years was admitted to the Mount Sinai Hospital, service of Dr. Beer, on June 18, 1928. Four weeks previously an ischiorectal abscess was incised, leaving a discharging sinus. Nocturnal frequency had been noted since the onset. Two weeks ago a tender mass had appeared in the left scrotum and had increased to the size of a peach.

Previous History. No venereal disease. No trauma. Bedwetting until five years of age. Measles.

In 1917 had pain on urination, gradually thinning stream and finally complete retention. At the Fordham Hospital he was catheterized with difficulty and discharged in a few days without further study.

In 1918 an abscess of the right scrotum formed, was incised at home and left a sinus which never healed permanently. In 1920 he noticed the urinary stream was again thinning and had a cathetor passed. In 1927 he passed an examination for life insurance.

Examination showed the right epididymis hard and irregularly thickened, with a small scrotal sinus at the lower pole. To the left of the raphe and attached to the corpus spongiosum was a fluctuating swelling about 4 cm. in diameter. To the right of the anus was a partly healed wound. The prostate was slightly enlarged and tender.

At operation for the periurethral abscess attempts to pass sounds, filiforms, etc. met an impassable stricture of the bulbomembranous urethra. A probe in the perineal sinus passed toward the deep urethra. Albolene injected through the meatus came out of the sinus. After incising the periurethral abscess a sound passed into the urethra could not be felt in the depth of the abscess cavity.

After operation urine discharged from the new wound on each voiding. The stricture was gradually dilated with Phillips filiforms and catheters up to 18 F. and then with natural curve silk catheters to 22 F.

On August 1, 1928 he was struck by an automobile and sustained a fracture of the pelvic girdle. While at the St. John's Hospital he had urinary retention but catheterization was accomplished. On September 6 he again came under my care complaining of severe pain on voiding and the discharge of urine and pus from the wound which had been made to drain the periurethral abscess. He was passing 90 per cent of his urine through the meatus with a fair stream, no residual. Hot baths and wet dressing to perineum were advised, alkalies and belladonna. On September 18, four days after passage of an 18 F. sound the old ischiorectal scar reopened, discharged pus and urine and thereafter most of the urine was voided through this sinus.

On September 24 he was readmitted to the hospital. A roentgen-ray examination of the pelvis and lumbar spine showed the fracture of the left pubis and ischium, sustained on August 1. There was also found a large irregular calcified mass in the right kidney area, which first suggested the tuberculous nature of the process. The bladder urine was examined several times for tubercle bacilli but none found. The phthalein output was 65 per cent in four hours. After dilation with sounds up to 22 F. cystoscopic examination showed a diffusely inflamed bladder with areas suggestive of tuberculosis. The right ureteral orifice could not be seen. The left appeared normal and yielded clear urine with good indigocarmine output in five minutes. Urine from the left kidney injected into guinea pigs showed no evidence of tuberculosis.

From October 12 to December 17 ambulant treatment consisted of passing a 22 F. sound every week or ten days, a procedure which was extremely painful. Despite sandalwood oil internally and continued use of heat and wet dressings the nodular induration deep about the urethra persisted and the urination was frequent with pain, tenesmus and burning. Another periurethral abscess formed and had to be incised. The leakage of urine from the sinuses decreased, however.

On his third admission to the hospital cystoscopy under epidural anesthesia showed

* Presented before the Section of Genito-Urinary Surgery, New York Academy of Medicine, March 20, 1929.

polypoid edema of the trigone. The left ureter was easily found, catheterized, and yielded clear urine. In the region of the right ureteral orifice was a polypoid prominence above which was a slit which could be entered only 1 cm. No efflux was seen. The posterior urethra was covered with a grayish exudate. Injection of the perianal sinus with indigo-carmine failed to enter the urethra. Curetting of this sinus and of the scrotal sinuses showed typical tuberculous granulation tissue.

Roentgen-ray examination of the chest showed an old tuberculous focus in the lower part of the right upper lobe, and some fibrotic areas in the left lower lobe.

At the suggestion of Dr. Mann irradiated ergosterol (vigantol) was administered, 2 drops daily for three weeks, beginning January 10. After ten days the urinary frequency had been reduced from every fifteen minutes day and night to every two to three hours by day and once at night.

Then the Alpine lamp generally and carbon arc locally were employed. The patient's general condition improved materially. He gained 17 pounds. Leakage from the sinuses has ceased except for an occasional drop from the perianal sinus.

From the evidence available we can diagnose an old occluded right renal tuberculosis, an old right tuberculous epididymitis, a tuberculous urethral stricture with periurethral abscesses and fistulas. If heliotherapy fails to relieve the bladder symptoms permanently an implantation of the left ureter into the sigmoid may be necessary.

CONGENITAL CYST OF URACHUS*

Samuel Lubash, M.D.

NEW YORK

THE patient, a young man, twenty-two years of age, first came under my observation some three or four months ago. His previous history was negative, until six years ago when he first noticed a sensation of tugging and pain in the region of the umbilicus with each act of micturition. However, he did not apply for any medical care.

About two years ago he first noticed a pussy discharge from the umbilicus, and again sensed pain and tugging at the umbilicus with each act of micturition. He consulted a doctor, who cleaned up the umbilicus with an antiseptic solution, after which the discharge ceased but the discomfort and pain in this region still continued.

Six months ago he experienced a severe attack of pain throughout the abdomen, and his physician made a diagnosis of appendicitis. He was referred to a surgeon, who operated upon him, and the data received from the surgeon, as well as from the hospital where it was performed, was that a mass had been found in the midline subperitoneally, which ruptured in the surgeon's hands and discharged an enormous amount of pus. The wound was simply drained. The appendix at this time was found to be normal. After a stay of six weeks in the hospital the discharge ceased and the man was sent home.

He felt much better until about four months ago, when he again complained of a discharge at the umbilicus, associated with the same sense of tugging and pain every time he voided. Various examinations were made and found negative, including a complete cystoscopic study. Cystogram was made to rule out a connecting link between urachus and the bladder, but that also proved negative. An injection of sodium iodide into the umbilicus by means of a catheter, to determine the direct line of the sinus was then made. Roentgenograms of this were taken in both the lateral and in the anteroposterior positions to determine its exact location and the size of the cyst duct.

From the lateral view we would be led to believe that it led directly into the midline down toward the bladder, but from the antero-

*From the Urological Dept., Flower Hospital. Read by invitation before the Section of Genito-Urinary Surgery, New York Academy of Medicine, March 20, 1929.

posterior position this idea was totally upset, for there we found a cyst pocket in the right lower quadrant.

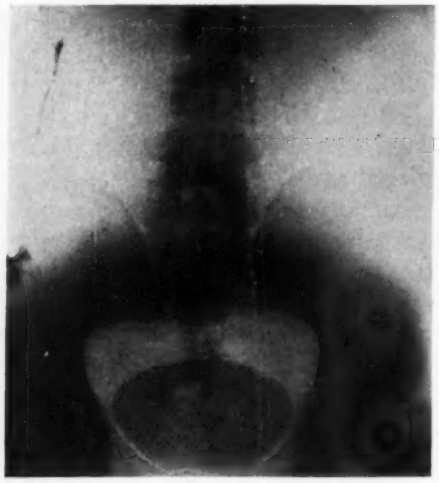

Fig. 1.

Our injection was less than 5 cc., which means that from the size of the encysted sac there must have been quite a retention of pus. Immediately following the injection patient went into complete shock, and after resuscitation he was put to bed. The following day we expected to do a gastrointestinal series to determine, if possible, a connecting link between the encysted sac and the small intestine, for it was thought that we might be dealing with some congenital anomaly of the intestinal tract for which we had to revert back to our embryological anatomy for diagnosis. That evening, however, the patient became worse and showed signs of acute peritonitis. The blood count rose from 12,000 to 24,000 white cells, and from 78 to 85 per cent polymorphonuclears, so that an immediate operation had to be performed.

Fig. 2.

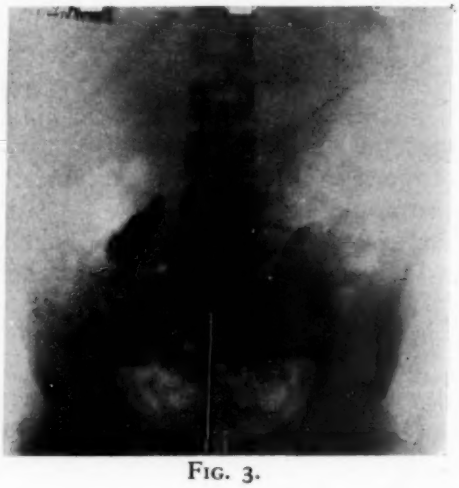

Fig. 3.

On opening the abdomen we immediately found the hepatic flexure of the transverse colon to be extremely dilated and congested. Again the patient went into shock on the table, so that a quick Mickulicz operation had to be done. The urachus was snared off from the umbilicus, and brought down to the lower angle of the wound, where it was tied off and removed with the insertion of drains, and the patient returned to bed.

After a severe and stormy convalescence, he recovered. Microscopical study of a section of the tissue removed showed numerous mucous glands and areolar tissue with a connecting layer of connective tissue.

DISCUSSION

Dr. Aschner: The histology of the lining of the sac would indicate that it was intestinal in origin, but mucous glands can also occur in the bladder. The latter is formed from the cloaca which has both intestinal and epidermal elements. We know that the allantoic duct and the vitelline duct are in close proximity in the umbilicus, and it might be difficult to determine which of these two structures gave rise to the cyst, for both are of entodermal origin.

Dr. L. R. Kaufman: The point made about the character of the cyst lining confirms a suspicion we had at the time of operation. At first it was thought that the condition was rather similar to a simple peritoneal abscess excepting that there was a definite degenera-

tive cyst which was adherent to the umbilicus. It took a direction to the right but became extraperitoneal below the region of the operative field. The discussion at the operative table was somewhat prolonged and we decided to have a scientific determination made later on lest the patient suffer too much from the discussion.

The specimen was studied by the pathological department, which left us to take our choice; but we thought it was an irregular urachal rather than an omphalo-vitelline cyst.

Dr. L. T. LeWald: I think the use of opaque material in the study of this case is unique in this particular type of lesion and that Dr. Lubash used the material that most of us use, sodium iodide. One might have used lipiodol or some similar iodized oil rather than bismuth paste, which might give trouble later on. I think the abdominal symptoms probably were coincidental. I do not see the connecting link between the injection of the cyst and the reaction the patient had. Dr. Lubash emphasized the necessity of taking views at right angles instead of only anteroposteriorly as usual. He reversed the usual procedure and made the lateral view first, and fortunately made an anteroposterior one later, which showed the cyst projecting to the right of the median line.

Dr. Lubash, closing: The previous operation was only a drainage of this sac which had ruptured into the peritoneal cavity. It is said in the literature that these cysts lie behind the muscles and just above the parietal peritoneum, but if they become distended they may burst into the peritoneal cavity.

The reason this man had an intestinal reaction I believe is that due to my injection of sodium iodide, added to the already encysted pus pocket, I caused a rupture into the peritoneum.

Before closing, I wish to call the attention to the rarity of this condition. At the Brady Urological Foundation only 2 cases were seen in a service of over 20,000 admissions. In Dr. Beer's service at Mt. Sinai Hospital, 1 case was found. In the service of Dr. Keyes at Bellevue Hospital 1 case was found. Vaughan has collected 52 cases in the literature. and Weiser 86 cases.

APROPOS GASTRECTOMY*

H. B. Epstein, M.D.

NEWARK, N. J.

WHILE well aware that the tendency of the pendulum in surgery is to swing to the extremes when some new procedure is advocated, nevertheless we find that the test of time evaluates the problem and either accepts a given discovery or casts it into the discard.

The evolution of the operation of gastrectomy is in reality a romance. We may say it is to Billroth that we owe the glory of refining the indications and technique. In reviewing his paintaking but discouraging results in the beginning, one is staggered by the indomitable courage which he exhibited in the face of a mortality rate ranging from 90 per cent to 98 per cent, and his conclusion "It will take a mountain of corpses to develop our art." Since his death, this work has been elaborated by many workers. The outstanding surgeons to whom we are indebted for elaboration in the operation being Von Haberer of Dusseldorf, Germany, Finsterer of Vienna, and Berg in the United States.

In our own country we have been loath to accept gastrectomy except in carcinoma ventriculi, American surgeons in general claiming that the Mayo posterior gastrojejunostomy suffices in most if not all indications, such as ulcer and stenosis chiefly.

The leading British surgeons, Moynihan, Healey, Bannet, and others, are inclined

* Submitted for publication April 13, 1929.

the same way so far as indications are concerned. Nevertheless, in their conclusions they feel much as the writer, that what the outcome is going to be in just such cases as this even with the aid of roentgen rays and other laboratory

Fig. 1. Fig. 2.

Figs. 1 and 2. Case IV. Before operation.

the scope of the operation is getting constantly wider. In this regard, there is a tendency to include, among the indications for gastrectomy, the bleeding types of gastric lesions, the bleeding ulcer, and extensive varices.

These conditions are, as a rule, dismissed with a brief word and we find in records of many hospitals that the rule followed is to enforce rest, with Sippey diet, and if the bleeding is arrested, to discharge the patient with a prescription for an alkaline mixture, only to have another bleeding period, followed by procrastination, the patient's resistance lowered, a hydremic condition of the blood with the pathology ignored, and morbidity and mortality increased. With this complication of bleeding there is a distinct practice to delay, and in 1 case where I followed the orthodox custom of "masterless inactivity" I allowed the patient to fill his jejunum and ileum with blood from a callous ulcer on the posterior wall of the stomach where the fibrosis retracted the edges of the vessel, and the patient was thus allowed to bleed to death without a chance.

To my mind, it is impossible to prophecy methods. While protesting against such lack of proper treatment, surgeons will tell you that more cases die with surgery than without it. Since that case, I have operated after hemorrhage; fortifying my patients with transfusion and hypodermoclysis, and have as yet no cause to regret it.

The advantage of this operation may be gained by a study of the bleeding cases where, in the period between bleedings, the patient has been brought to a fair standard of health to permit this radical measure; and where with rest, Sippey diet, and transfusion in selective cases, it should be the proper indication.

Some of the contentions against gastrectomy are reasonable, some puerile. In the case of duodenal ulcer, under most circumstances a well-performed Mayo operation suffices in from 75 per cent to 90 per cent of the cases; but in cases of extensive ulceration about the pylorus, or a lesion unrelieved by gastro enterostomy, or where the ulcer is on the posterior gastric wall with adhesions to the pancreas, gastrectomy should be performed. In stenosis also, where we may find the pyloric end of the stomach converted into fibrous

tissue, adding another indication, and when ulcers of the lesser curvature with hour-glass contractions are present, a sleeve resection fulfills the indication perfectly.

Some of the objections to gastrectomy which have been voiced by general surgeons have been: "Why remove a considerable portion of the organ when the pathology is small?" Others object that the operation offers technical difficulties which the general surgeon is not fitted to perform.

In answer to the plea that only the special surgeon should undertake this work, I agree that this is an operation requiring great attention to technical skill, speed, preparatory work-up, etc. Nevertheless I cannot reconcile myself to the inability of the surgeon who possesses a large surgical service, to perform an abdominal operation which can under ordinary circumstances be performed in forty-five minutes, with attention given to selecting good assistants, transfusion, skillful anesthesia, careful nursing, and preoperative and postoperative attention.

After all, results and the reporting of the results go a long way toward establishing a claim for any given procedure. I am sure the operation will be performed in larger numbers when we rid ourselves of a rather unreasonable reserve.

While the operation is a more serious one, than other accepted methods, the results are more prompt, the cures more brilliant, there are fewer recurrences of the primary lesion, a shorter period of convalescent adjustment, and finally, there is a more rapid progress to normalcy or cure, and rarely any necessity for reoperation. Then, the unsatisfactory results after gastroenterostomy, when the necessity of undoing the anastomosis and adding some conservative technique only creates more adhesions in the face of a condition of diminished resistance. Further, the mortality rate is hardly greater than after gastrojejunostomy.

The following 4 cases show four different conditions following one another and resulting in such prompt recovery that I feel that we should plead for establishing a wider scope for this splendid addition to progressive surgery.

Fig. 3. Case iv. Roentgenogram taken after recovery. Showing removal of diverticulum and anastomosis functioning very well.

Case 1. A. C., a girl, aged nineteen. Menstrual and family history normal. Had suffered pain in stomach before and after eating for three years. During this period had frequently vomited sour food, but no blood. Pain was temporarily relieved by food, then would return in about an hour after eating. Also had experienced considerable relief by use of bicarbonate of soda. During last few months before operation, pain was not relieved by bicarbonate of soda and the vomiting had increased; had lost 30 lbs. in weight.

Examination: Poorly nourished, anemic, and weak. There was marked tenderness in the upper right quadrant. Roentgen-rays by Dr. Erwin Reissman, revealed a ring of ulceration about the pylorus.

Operation, October 17, 1927: Opened abdomen exposing a large indurated mass surrounding the pylorus; resection performed and posterior gastroenterostomy. The patient was transfused. Made an uneventful and perfect recovery.

Case II. J. V., a man, aged fifty-two; past history and family history normal, except that he had had gastric disturbances for twenty years. For fifteen years had been taking large doses of bicarbonate of soda in 7 or 8 daily doses. This helped in the beginning, but as he grew steadily worse, he was forced to take larger and larger doses until it was entirely uneffective. For the last seven years before operation, patient had been going from one doctor to another. Operation always recommended.

Two years before operation, nausea and vomiting began. Meals caused severe substernal pain. Near the end of this period, vomitus was streaked with blood. During the last four weeks before operation, could take no food at all and had lost weight very rapidly.

Examination: General condition very poor, anemic, and some jaundice present. Marked tenderness. Roentgenograms showed complete stenosis at pylorus.

Operation, August 17, 1927: 300 c.c. blood; 750 c.c. saline. Opened abdomen; pyloric end of stomach found converted into fibrous tissue, no glandular structure found. Subtotal gastrectomy performed and posterior gastroenterostomy. Saw patient in May, 1928. Present weight, 152 lbs. Eats everything. Has no pain.

Case III. A. J., a woman, aged fifty-two. Menstrual and family history normal. Had suffered pain in left lower quadrant and along left anterior flank for a number of years. At first the pains were largely intermittent lasting for only a brief interval, but for a few weeks before the operation the pains were more severe and for the most part continuous, at first "sticking" in character and again just aching. They were attended with nausea and vomiting but not relieved by the vomiting. The pain radiated up along the left flank to the heart area, but chiefly to the epigastrium where there was marked tenderness. Vomitus consisted of food, but no bile or blood. Pains had no relation to meals and were not relieved by soda. Marked anorexia with loss of 30 lbs. in last three months. No fecal or urinary disturbance.

Examination: Fairly nourished. Marked tenderness in the epigastrium and gall-bladder region with some rigidity. Marked tenderness in the left paraumbilical region and rigidity of the upper half of the left rectus muscles. There was active pulsation of the aorta definitely and easily palpable. Otherwise, abdomen was negative. Over the pulsating area was a semblance of a hard mass. Roentgen-rays, showed large perforating indurating ulcer of the lesser curvature with hour-glass contraction.

Operation, December 6, 1928: Resection of ulcer. Linen suture for serous coat. Sleeve resection. High median incision. Abdomen closed in layers. Patient reported April 2, 1929 in splendid health and no complaints.

Case IV. J. B., a man, aged thirty-four. Family history, normal. Two years previous to operation he had an attack of sudden weakness after a bowel movement which, as he described it, was of a "coffee ground" nature.

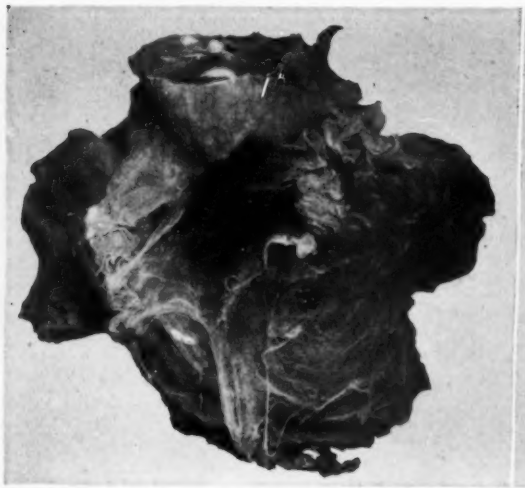

Fig. 4.

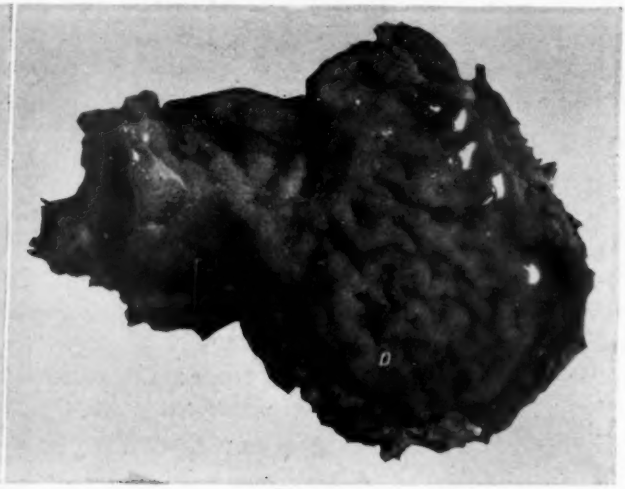

Fig. 5.

Figs. 4 and 5. Case IV. Gross specimens showing diverticulum removed with ulcer on the edge.

Two weeks later he had an attack of vomiting, the vomitus was also of a "coffee ground" nature and was also accompanied and followed by profound weakness. After that he enjoyed a period of good health with the exception of obstinate constipation that necessitated the use of purgatives two or three times a week. On September 5, 1928 he again suffered weakness after a bowel movement, this was also of a "coffee ground" nature and as he says, it probably contained blood.

Examination: Appearance, normal. No tenderness or rigidity of abdomen. No tumor masses palpable. Liver and spleen not palpable. Roentgen-ray showed a diverticulitis of the duodenum with a perforated ulcer.

Operation, September 17, 1928: Right rectus incision. Findings, Diverticulum of first portion of duodenum. Diverticultitis. Freed adhesions, resected pylorus and first portion of duodenum, and performed a posterior gastrojejunostomy.

At this time he is perfectly well. Has gained 20 lbs.

The 4 cases represent a set of lesions from among many that we have operated upon. They are cited with the motive of demonstrating a few of the diverse indications for a radical procedure.

If we can accept McCarthy's dictum that cancer is sometimes engrafted upon an ulcer base, we may excuse some operators for their radical ideas, inasmuch as after gastrectomy we sometimes find that the pathological report shows early malignancy.

Gastroenterostomy for uncomplicated duodenal ulcer, gastrectomy for the lesions indicated, should be our guide until something better can be demonstrated.

And finally, in those patients whose debilitated state will not permit a radical operation even with complete preoperative workup, a gastrojejunostomy somewhat near the cardiac end of the stomach should suffice, and later the resection can be done as a secondary operation with much less danger.

There is hardly a more discouraging crisis to face than in those patients who come to us, unrelieved, for help; who have undergone palliative operations, and in whom upon reoperation we find distortions, secondary ulcers, adhesions and twists, and diminished resistance due to inability to digest or metabolize properly, facing a greater mortality percentage, where the original conditions might have been met by gastrectomy.

So, weighing all the factors in mind, I am of the opinion that gastrectomy will take the place of the lesser operation much as cholecystectomy has replaced the drainage operation.

INTERMUSCULAR LIPOMAS*

REPORT OF THREE CASES

Moses Behrend, M.D., F.A.C.S.

PHILADELPHIA

LIPOMAS found in the superficial tela cause very little comment. One finds much written on the subject of intermuscular and intramuscular lipomas in the foreign literature. This accounts for some difference in the classification of these tumors, because in the translated articles the terms have been transcribed very loosely, some intramuscular lipomas being called intermuscular tumors and vice versa. Therefore in the future in order to classify these tumors properly overlapping of these terms should be avoided. This can easily be done by a careful analysis of the anatomical situation of the tumors. It can readily be seen, however, that a tumor may originate in the muscle and then gradually grow

* Read before the Hospital Conference, Jewish Hospital, April 16, 1929.

out into the intermuscular septum and thus occupy a dual position. Lipomas may grow within the muscle and stay there as encapsulated growths. Others may arise independently from the intermuscular fascia and stay there until removed. This type of tumor does not encroach on the muscle itself. These tumors, being benign, are well encapsulated, therefore they do not extend into the confines of their surroundings like sarcomas or carcinomas. Dege divides the subfascial tumors into intermuscular, submuscular, and intramuscular peritendinous, subsynovial, periosteal and subserous, and differentiates between them.

All of our cases were of the intermuscular type. These seem to be more common than the intramuscular form, but on account of the looseness in the use of the terms as already mentioned it is difficult to classify all the reported cases. Suffice it to say that lipomas whether they occur within or between the muscles are rather rare. In the literature reviewed for the past thirty-five years all the authors agree that this is a rare form of lipoma. One of our specimes (Figs. 1 and 2) is from the Daniel Baugh Institute of Anatomy of the Jefferson Medical College.[1] The professor of anatomy, Dr. J. Parsons Schaeffer, told me that this was the first instance of intermuscular lipoma observed in twenty-five years out of 2500 bodies dissected. Many lipomas of the common variety are observed every year both within and outside anatomical laboratory.

Some authors have included in this series tumors which are not totally composed of fat. This is obviously a mistake because lipomas should be those in which there is an increase of adipose tissue. Herzenberg feels, therefore, that very few tumors known as intermuscular growths fit in. This can readily be explained by the fact that there is comparatively a very small amount of fat in the intermuscular fascia and in the muscles themselves, in the lean naturally a negligible quantity, while in the stout there is quite a deposit of fat even in the muscles. Our specimens were derived from those of medium stature. Some authors (Ziegler, Schmaus and others) have considered it pathological to find fat in and on the musculature. Wahlbaum states that fat may be found in those places in normal muscles.

Kuttner collected 25 cases from which it is apparent that the leg and the arm are infrequent locations for these tumors. Prior to this Cruveilheir and Paget collected these rare growths. Hofmeister and Schreiber, Reichel, Danielson, Canaguier, and Morestin affirm the observation that these tumors follow traumatism. In Herzenberg's case the tumor was under the extensor communis digitorum. On account of the kidney and heart condition it was removed under spinal anesthesia. Szenes reports a case of angioma under the masseter muscle. This began, however, as a lipoma. It was first noticed when the patient was two years old. From 1853 to 1906 Dege found 23 cases. Nast-Kolb discovered 32 definite cases in the literature. He adds another and reports the case of a woman thirty-five years old who noticed that for a year her right thigh was increasing in size. He does not believe trauma is much of a factor in the formation of intramuscular tumors. L. Pichler has observed 5 cases, 2 of them coming to autopsy. The latter were within the muscle, while in cases III and IV they were in the fascia. The fifth case was not mentioned. Bufalini reports the case of a woman aged fifty-five who noted the presence of a tumor in the posterior portion of the left arm, caused by traumatism. He gives a long dissertation of the differential diagnosis between tumors in general. Careful examination of the literature gives a total of 189 cases of deep or subaponeurotic lipomas besides the author's. This includes 148 cases collected by Dertinger up to 1903, 23 by Dege, 8

[1] The tumor was located under the trapezius muscle in the intermuscular septum.

by Taddei and 9 collected by the author in the past few years. Angeletti reports a tumor of the right temporal region which was of the intramuscular variety. Moriconi reports an intramuscular lipoma of the axilla under the right latissimus dorsi. He insists on the proper designation of the tumors according to location: intermuscular between the muscles and intramuscular within the muscles, "in the adipose cellules of the perimysium." Robb reports a case of intermuscular lipoma of the calf in a woman forty-one years old. It grew from the interosseous membrane, having been noticed for at least eleven years. Dubar and Potel quote Depres who said in 1866 that there never has been a lipoma found within the sheath of the muscle. But two years later he had to recall this statement. In 1875 Farabeuf states that muscular lipomas are unique. Paget, however, in 1856 mentioned a case of lipoma which had developed in the thickness of the trapezius muscle. Dubar and Potel report a case in a woman seventy-two years old, in whom the tumor was located at the level of pectoralis major muscle. It resembled sarcoma on account of its rapid growth. In summarizing they say that intramuscular lipomas are very interesting to study, quite rare and often more easy to extirpate than to diagnose. Laurenti reports a congenital lipoma of the right masseter muscle in a girl three years old. Since birth she had had a soft tumor in this area. Morestin reports a congenital intramuscular lipoma in a man twenty-three years old. It was in the left calf, dated from early infancy and was situated in the internal head of the gastrocnemius muscle. The entire tumor could not be removed on account of its attachment to muscle. Tagliavacche and Casanovas report 4 intermuscular lipomas. Weaver found one in the semitendinosus muscle. Ziegler states that they are rare, but Sutton says there are many examples of fatty tumors in the midst of muscles. Senn says they come from the fat of the mesotendon.

The symptoms of lipomas are those of benign tumors. Naturally these depend upon the size and location, the larger the

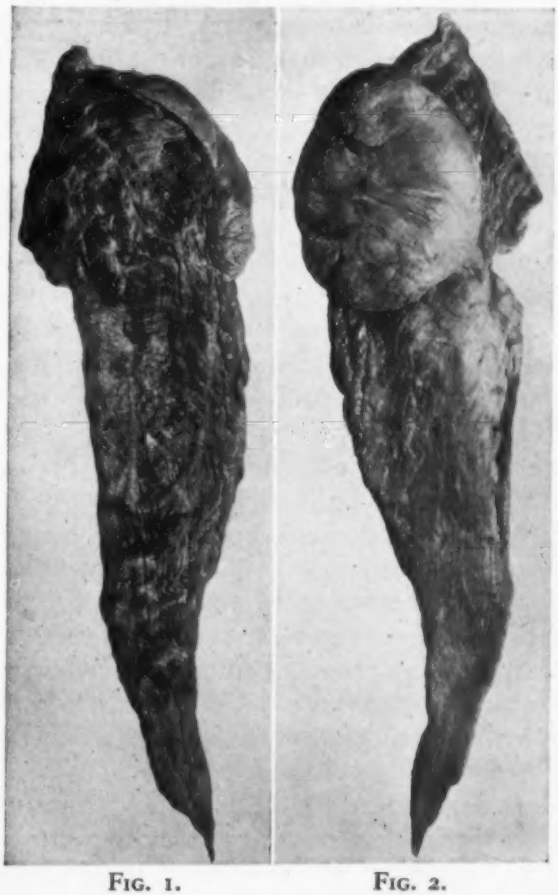

Fig. 1. Fig. 2.

Fig. 1. Dorsal surface of trapezius muscle with lipoma showing at its border. Specimen from The Daniel Baugh Institute of Anatomy.

Fig. 2. Ventral surface of trapezius muscle showing tumor in its entirety. Specimen from The Daniel Baugh Institute of Anatomy.

tumor the greater the discomfort. The nearer the tumors to large nerve trunks, the greater will be the pressure symptoms. Patients usually object to their presence on account of the deformity and not the pain due to these growths.

The differential diagnosis is of more importance and greater interest. Most of the authors who have written on the subject pay much attention to the distinguishing points. Sometimes great difficulty is encountered in the differentiation. Schreiber described a tumor in the biceps of a young woman which was thought to

be a sarcoma, at operation it was found to be an intermuscular lipoma. A quite analogous case was operated on at Bruns clinic by Hofmeister in 1907. Intramuscular and intermuscular lipomas may be taken for angiomas, sarcomas or muscle tuberculosis. In Herzenberg's case the diagnosis was so indicated that he could determine the existence of a muscle tumor. An exploratory puncture withdrawing some fatty material will always confirm the diagnosis. Unless there is some contraindication the exploratory puncture is of great benefit in our final analysis. In mentioning the difficulty in diagnosis Nast-Kolb refers to a case (1858) in which an amputation was done for a deep-seated lipoma on the supposition that the fast growing tumor was malignant. Certainly this could not happen today. Roentgenography will show the difference between sarcoma and lipoma except when the malignant tumor grows from and in soft tissues. It will demonstrate whether the tumor is connected with bone. Bufalini in calling attention to his case believes that the anatomico-pathological diagnosis is more important than the clinical, because the exact clinical diagnosis is quite difficult.

In addition to the case referred to above found in the anatomical laboratory, we wish to add 2 cases operated upon in my service at the Jewish Hospital.

C. B., aged fifty-two, engineer. Operated upon by Dr. M. Segal. Patient noticed a lump on the back five months before admission. Under local anesthesia it was necessary to incise the trapezius muscle and remove the tumor from under it.

L. S., a woman aged thirty-nine. Operated upon by Dr. V. A. Loeb. She complained of a large mass on the left thigh which caused pain on exertion. It was first noticed three years previous. Roentgen examination was negative. The mass was large, movable and firm on palpation and apparently not lobulated, growing more toward the median line. It did not have the appearance of a psoas abscess or of a femoral hernia. The veins were greatly dilated in the region of the tumor. A diagnosis of lipoma or fibroma was made. A curvilinear incision was made on the lateral surface of the thigh. A tumor measuring 12 by 12 by 10 cm. was revealed. The section of the tumor was composed entirely of fatty tissue.

From the foregoing it is evident that intermuscular and intramuscular tumors are rare, in all about 190 cases being reported exclusive of those mentioned by the author.

Greater care should be taken in the future in the classification of these tumors.

It is obvious that with the help of the roentgen ray these tumors will be easy to differentiate from malignant tumors and those connected with bone.

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INTUSSUSCEPTION

INVOLVING DISTAL ILEUM, APPENDIX ASCENDING AND TRANSVERSE COLON*

WILLIAM L. HEEVE, M.D., F.A.C.S. AND RUDOLPH GOLDBERG, M.D.

BROOKLYN

M., three years of age, complained of pain in the stomach, while playing in the street in the afternoon, May 10, 1928. The mother immediately brought the child into the house and gave her a soap-suds enema, which relieved the pain. The child was put to bed for the day. About 9.30 P.M., the child again complained of pain, saying it hurt more than the pains before, and, after crawling around the floor like "a snake" went to bed and slept through the entire night without complaint or disturbance. The next morning the mother gave the child 1 tablespoonful of milk of magnesia. About one-half hour after the administration of the magnesia, the mother called one of us (R. G.). At this examination, May 11, 9.30 A.M., the child presented a normal temperature, pulse 84, respirations 24, no tenderness or rigidity of the recti muscles, no tumefaction of the abdomen. In fact the entire examination was negative with the exception of a pair of hypertrophied tonsils. No medication was prescribed at this time, but the Mother was advised to get in touch with the physician, if the child complained of any more pain.

At 11 A.M. the author was called to see the child again. At this time the mother stated that since the morning examination the child complained of colicky pains which would "come and go" and at 10.30 A.M., when the child attempted to have a bowel movement, she cried out from severe pain, and when the mother picked her up, she noticed the bed-pan full of blood and a piece of "red meat" (prolapse) protruding from the rectum. By the time the second examination was begun, the prolapse of the rectum had receded and the child was lying quietly in bed. At this examination there was slight tenderness and muscular rigidity over the left rectus at the level of the navel; there was also a slight elevation of the muscle (mound) at this location. At this time the child vomited twice and both times the vomitus contained mucus. The temperature was 99° F. rectally, pulse 84, respirations, 24. The child appeared quite comfortable during this second examination. The mother was advised to keep the child in bed, place an ice bag on the abdomen and not to give anything by mouth. The mother was also asked to save the next bowel movement. At 1.30 P.M. another hurry call was answered, and, at this time the mother said that the child had a bowel movement and the "raw meat" protruded again. The bowel movement was of a mashed beet consistency, but the prolapsed rectum had disappeared (receded). About five minutes later, while being examined, the child had another bowel movement which was of a mashed beet consistency and color. The abdomen was examined and the tenderness and rigidity of the left rectus was more marked than before. The mound was considerably higher than before and had assumed a definite elongated shape. A diagnosis of intussusception was made and operation advised immediately. The parents refused, but an hour later telephoned and asked for a consultation. The senior author was called as the consultant, and the same diagnosis made. At the time of his examination the tumefaction was larger and more sausage-shaped in form. The parents then consented to operation and the child was rushed to the hospital.

The child was brought to the operating room as soon as preparations were made. Ether anesthesia was used. A left rectus incision about 3½ in. long was made, extending about 1½ in. above the navel. The peritoneum was opened in the usual manner and immediately there was seen a large mass lying in the left side of the abdomen, bent upon itself and resting on the descending colon. This was delivered through the opening and examined. It was found to be an invagination. The contents were released by pushing from the proximal end first, then from the distal end of the invagination. First came the distal ileum, followed by a thickened appendix, which was about 3½ in. long, this in turn being followed by the ascending and transverse colons respectively. The invagination totaled about 9 in. The contents of the invagination were avascular, and

* Submitted for publication May 4, 1929.

hot laps of saline soon restored the blood circulation. However, the tip of the cecum was very free and quite edematous and required more time to bring its circulation back. Appendectomy was performed in the usual manner. The various parts of the invagination were placed in their anatomical positions but not tucked down. The abdomen was closed in the usual manner, without drainage.

LABORATORY FINDINGS

Preoperative and postoperative urine specimens were negative. Blood count: total red 3,670,000; total white 4,400; polymorphonuclears, 48; lymphocytes, 47; mononuclears, 3; transitional, 1; eosinophiles, 1.

Pathological report of the appendix: Macroscopical examination: Appendix whitish in color, smooth externally with dilated external venules measuring about 5 by 1 cm. On cut section portions show the lumen obliterated while in other parts the lumen is round and contains some exudate. The wall is thickened.

Microscopical examinations: Fibrous connective tissue displaces the mucosa in portions and the other coats are infiltrated with fibrous connective tissue and round cells. The blood vessels are thickened and congested. The part of the appendix that is not obliterated show considerable infiltration with polymorphs, serum exudate and some blood in the lumen, mucosa and some in the submucosa.

Diagnosis. Acute exacerbation of a chronic appendicitis (obliterans).

The child had an uneventful postoperative period, having a bowel movement with a soapsuds enema on the third day, one on the fifth day with the same procedure, one on the seventh day with milk of magnesia and on the ninth and tenth day a natural bowel movement.

The child left the hospital on the eleventh day postoperative.

XANTHOMA OF TENDON SHEATH*

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XANTHOMA of a tendon sheath is of such infrequent occurrence that the report of cases as observed is justifiable.

W. W., aged seventy-five, male, white, American, retired florist, in excellent health considering his years, was seen because of a growth on the left wrist, that was first noticed thirteen years before, as a small painless "kernel." Gradual enlargement went on for ten years. In the past three years, the increase in size has been noticeably more rapid. He is now unable to fasten his cuff. Pain has gradually developed, until one year ago the pain became severe, involving the two outer fingers, the ulnar side of the arm and the elbow. Recently the pain has been paroxysmal, causing insomnia.

Family History. Father died of a malignant growth of the neck which began as a black mole and finally involved the jugular vein. Mother died of fractured skull aged seventy-two. Has several brothers and sisters living and well.

Past History. Has had typhoid fever and pneumonia, no accidental injuries or surgical operations. Cannot recollect any trauma to wrist before growth was noticed.

Examination. General examination yielded nothing of note, except the growth hereafter described. Blood and urine showed nothing of interest. Wassermann reaction was negative.

Left Wrist: projecting outward, just above the head of the ulna, is an ovoid mass, about the size of a goose egg, quite firm and slightly nodular, freely movable, no evidence of bony enlargement or of attachment to the ulna. (For this reason, a roentgenogram was not taken). Displacement of the mass toward the dorsum of the forearm caused pain in the distribution of the ulnar nerve.

Operation. At the Northwestern General Hospital, 1 per cent novocaine solution being used by infiltration, a 4 inch linear incision was made laterally over the mass, through

*Submitted for publication May 23, 1929

the skin. Fat of deep yellow color protruded. This fat was incised over the middle of the mass to a depth of ¾ inch. As no other type of tissue was found, provisional diagnosis of hepoma was made. Blunt dissection was carried upward toward the elbow, and as it proceeded, we found that the fat became thinner, finally reaching a thin edge. This was retracted and a gray smooth mass exposed. Delivery of the tumor was attempted, but there was such severe complaint of pain in the ulnar distribution, that gas-oxygen anesthesia was administered. Careful separation of the tumor from the surrounding tissues was accomplished, and the growth brought out of the wound. It was then found that the ulnar nerve, with the sheath and tendon of the flexor carpi ulnaris passed through the tumor near its base. The nerve, tendon sheath and tendon were dissected free and the tumor removed. It was then found that the capsule, of which we could demonstrate three layers, arose from the tendon sheath. The excess capsule was removed, the gap in the sheath closed. The fat was examined and found to be disc-shaped, quite thick in the center, but becoming uniformly thinner as the edge was approached. This was not removed. The wound was closed by interrupted sutures. All sutures were chromic cat gut.

There was no postoperative reaction, the man being discharged two days later to his home, to come under the care of local physician. I have seen him on three different occasions in a six-month period. The wound closed and healed with no infection. There has been no recurrence, and the patient is comfortable.

Pathological Report. The tumor was submitted to Dr. Louis Tufft, pathologist at the hospital. His report and comment follows: Gross examination: specimen consists of a tumor measuring 5 by 4 by 4 cm. It is well encapsulated with a very thin fibrous capsule which is smooth. Section cuts readily revealing a yellowish, bulging tissue which is slightly firm to the touch. Microscopically, tissue is quite cellular and shows bundles of loose fibrillar tissue, interspersed with strands of a dense connective tissue, very cellular in character. Cells are spindle shaped and vesicular, with fairly definte nuclei which, however, do not show any tendency toward mitosis. In many areas, small round celled infiltration is present, evidencing areas of chronic inflammatory changes.

Scattered throughout are a few large multinuclear cells, giving the appearance of giant cells.

Comment: The section presents a rather unusual type of connective tissue tumor, springing usually from the tendon or muscle sheaths and called by some giant celled sarcoma of the tendon sheath, by others, giant celled tunor, and still by others, xanthosarcoma because of the lipoid material present. These tumors are perfectly benign.

Diagnosis. Giant cell tumor of the tendon sheath with chronic inflammatory changes.

Ewing[1] states.

The specific structure and benign clinical course of a group of giant cell sarcoma of tendon sheaths of the hands and feet, have long been recognized. They have been fully described, especially by French observers under the terms "myeloma" or "xanthosarcoma" (Gross, Paquet, Reverdin, Heurteaux, Spiess, Lit). The tumors arise chiefly in tendon sheaths and aponeuroses of hands and feet, and reach moderate dimensions after a period of 1 to 20 years. Sudden increase in size may arouse a suspicion of malignancy, but they seldom reach the size of an egg. They are well encapsulated, firm, opague or yellowish and markedly lobulated, and are readily shelled out by operation. They never yield metastases and rarely recur after removal.

Etiological factors are very indefinite, but the structure and benign character of the process suggest that the tumors arise from a local inflammatory process connected with trauma and some peculiar disturbance of local lipoid metabolism. Fleissig denies that they have any neoplastic quality and regards them as a form of granulation tissue, yet similar arguments apply almost equally well to many other sarcomas. They have often been classed with xanthoma.

McWhorter and Weeks[2] give a full bibliography and discuss constitutional factors. Janik[3] believes that injury plays an important rôle, and that the growths are more frequent in males than females.

SUMMARY

A tumor involving the sheath of the flexor carpi ulnaris, surrounding this tendon and the ulnar nerve, which had been slowly developing over a period of thirteen

years, is presented. The histological characteristics correspond (as does the history and gross findings) to the type of tumor known as giant celled tumor or xanthoma of the tendon sheath.

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RICHTER'S HERNIA

INCLUDING A CASE OF INTRA-ABDOMINAL SUTURE OF SAC*

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A STRANGULATION of part only of the circumference of the intestinal wall is a Richter's hernia. Treves[1] suggested the name, as Richter described the true condition in 1778. Occasionally it is called a Littré's hernia, but this name should be reserved for a hernia of Meckel's diverticulum.

There is general agreement that the ileum is most often strangulated, the patients are most frequently in the fifth decade, women are more often afflicted than men, and the condition is more apt to occur in old rather than in recent hernias. Preoperative reduction is rarely possible. The hernias are small, and strangulation is commonly the first evidence of trouble. The chief clinical importance is that strangulation at times fails to give rise to two of its cardinal signs, complete obstruction and fecal vomiting. Due to intermittent passage of gas and feces, the diagnosis of obstruction or strangulation may be so delayed that gangrene of the constricted portion may supervene.

In some cases gangrene has occurred and a spontaneous recovery resulted, leaving the patient with a fecal fistula into the scrotum, groin, or at the umbilicus. This has happened only with the inguinal ring strangulation. All of the femoral ring strangulation cases have died unless relieved by operation.

This possibility of a partial strangulation in cases clinically resembling intestinal obstruction shows how important it is to make a search of all hernia rings in cases operated on for obstruction.

Rhodes[2] recently reported 3 cases, all of the inguinal type. His cases bore out the above generalizations, and also Scarpa's observation that a two-third constriction produces complete obstruction, but a one-third constriction gives only partial obstruction. The cases reported here do not bear out this statement of Scarpa, as both had complete obstruction, with fecal vomiting, for over three days, though only a small part of the gut wall was involved.

The symptoms are not uniform and are misleading, sometimes being typical of an intestinal obstruction, more often not. All cases have some symptoms suggestive of a partial or complete obstruction. One should be suspicious of a Richter's hernia when the present illness was ushered in by the incarceration of a long-standing hernia, and where the illness persists even though it is believed that the incarceration has been reduced. The reduction, of course, has not been complete. The pain is diffuse and colicky, and may be over the ring involved. Vomiting is generally present, but is frequently of a mild or intermittent type. Fecal vomiting is present in a small percentage of cases, but the bowel may be gangrenous without fecal

* Submitted for publication May 31, 1929.

vomiting. Constipation is a consistent symptom. In a few cases diarrhea has been a feature, and is a bad omen. Laboratory findings give little assistance.

Many cases have been allowed to progress because a small, slightly tender, inguinal or femoral lump has been diagnosed as an "inflamed gland." In suspicious cases it is better to cut down on an inflamed lymph node than to miss a strangulated hernia.

The mechanism of this hernia is obscure. No explanation advanced so far seems to apply to all. In one of the cases reported here the internal inguinal ring pinched the gut wall snugly. In the other it did not, rather the gut wall lay in the ring, bulging slightly into the canal as if a difference in pressure existed between the inside of the gut and the inguinal canal. This difference must have been very slight, as gentle traction lifted the intestine free.

The physical signs are vague and go with a partial or complete intestinal obstruction. There is generalized abdominal tenderness, and distention, and the tenderness over the ring involved may be more marked than elsewhere. It is difficult to palpate the strangulated intestine. Foote[3] suggests standing on the side of maximum tenderness and pressing with the dorsum of the examining hand on the abdominal wall parallel to and about 2 inches above Poupart's ligament. When the rectus has yielded, a firm gradual cupping movement of the ulnar side of the hand toward the superior ramus of the pubis brings a distinctly palpable mass between the palpating hand and the pubis just distal to the anterior superior spine. I have not tried the method.

The prognosis depends on several factors, but especially on the condition of the bowel. Treves[1] gives the operative mortality as 55 per cent, and the nonoperative as 75 per cent. Each of the nonoperative recoveries having an artificial anus. This mortality seems unnecessarily high. In a time consuming, but probably incomplete, search of the literature of the last twenty years I found 13 cases operated on with a mortality of 22 per cent.

Immediate operation is the only treatment, the bowel to be dealt with in the usual manner, and a radical cure of the hernia done. Resection of the gut is advocated if it is gangrenous, and the condition of the patient allows. Jones[4] reports a case in which the gangrenous gut was invaginated. This is possible only when the strangulated area is small. The usual postoperative treatment given obstruction cases is indicated.

Many of the cases will have the abdomen opened before the real pathology is discovered. Where the condition of the patient makes the further operation of radical repair of the hernia dangerous, I would call attention to the procedure adopted in Case 1. An intra-abdominal suture of peritoneum and fascia over the hernia opening has held firmly for almost six years. For that length of time there has been no hernia where one had existed for many years. This was a peritoneal suture, which, of necessity, included fascia. The impossibility of limiting a stitch to the peritoneum alone is assumed.

The technique for curing a hernia by laparotomy has been described.[5,6]

CASE REPORTS

G. N., aged forty-nine, male, white, farmer. Complained of abdominal pain, nausea, and vomiting of three and one half days' duration. At that time a right inguinal hernia came down, but he thought he had reduced it as he had done many times before. In spite of the disappearance of the hernia the pain kept up. He had passed no flatus or feces for over three days. Frequent enemas had returned clear. The patient looked very ill. His abdomen was distended and tender. It was most tender over the right lower quadrant, and especially tender just above the middle of Poupart's ligament. Rectal examination showed marked tenderness on the right side. Examining finger was introduced through the external ring and up the canal to the internal ring

without meeting obstruction or causing pain. A diagnosis of intestinal obstruction was made and an immediate operation done, December 5, 1923. The peritoneal cavity contained a large amount of fluid. The lower two-thirds of the ileum was distended, except for about 10 inches distal to a small part of the wall which was caught in the internal ring. This distal gut was collapsed. The intestine was almost purple in color, but contracted on stimulus. The incarcerated part was easily lifted free. Gas passed at once. The general condition of the patient was not good, so it was decided not to do a repair of the hernia. But as such good exposure of the ring was present a suture of the peritoneum and fascia was made over the ring. The wound was closed without drainage, and the patient recovered. He soon went back to heavy farm work, and reported March 14, 1929, that the hernia had never appeared since the operation.

J. C., aged fifty-two, white, merchant. Came in complaining of abdominal pain, distention, nausea and vomiting. He had had a right inguinal hernia for years which occasionally became incarcerated and painful, but which he had always been able to reduce himself. Such an experience started five days before I saw him. For these five days he had been observed with a probable diagnosis of appendicitis. When I saw him he looked very ill. His abdomen was distended and he was in great pain. He had just vomited fecal material. The maximum point of tenderness was in the right lower quadrant about 2 inches above Poupart's ligament. No mass could be felt in the inguinal canal, though pressure high in the canal caused pain. Rectal examination: palpation brought out marked tenderness on the right side. Many enemas had returned clear.

A diagnosis of intestinal obstruction was made, and an immediate operation done, December 23, 1923. Coming but a few days after the other case the question of whether this might not be another Richter's hernia was considered, but thought unlikely as no mass could be felt in the canal. Operation showed that 12 inches from the ileocecal valve the side wall of the gut was pinched in the internal ring. There was free fluid in the peritoneal cavity, and the gut was discolored. Traction on the ileum did not easily free the incarcerated piece, but an assistant's finger in the canal, coupled with traction from above soon freed it. Gas immediately passed the obstruction, and the color improved quickly. While the gut was plainly marked where it had been pinched in the ring, it did not look to be damaged, so the abdomen was closed in the usual manner. No drainage was used, and the patient recovered. As this man looked as if he might die no suture of peritoneum and fascia was made. To March, 1929 he has had no change in his usual routine of having to replace his hernia from once to three or four times a week.

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SUPRACONDYLAR FRACTURE OF HUMERUS*

LATE RESULT OF OPERATION FOR MALUNION

G. T. TYLER, JR., M.D.

GREENVILLE, S. C.

THE following case is of interest because of the happy outcome of an unpromising deformity resulting from the improper treatment of a supracondylar fracture of the lower end of the humerus.

J. K. eight years old, was seen first in January 1922. Four months previously he had fallen, injuring his left elbow. His physician applied a plaster cast. The hand and forearm swelled. The cast was opened, and the next day removed. Contractures of the fingers began soon after removal of the cast, and have increased. He could flex the elbow only a short distance.

When I examined him at his first visit, I made the following note: Prominence on the anterior surface of humerus just above elbow, inability to extend forearm completely, flexion of forearm possible only to 90°; Volkmann's contracture of hand and forearm, hand in pronation, supination impossible; dense scar tissue about middle of forearm on flexor surface; fingers sharply flexed and thumb atrophied, flexion and extension impossible. Patient a mouth-breather; tonsils enlarged. Roentgenogram of elbow (Fig. 1) shows deformity.

Operation, January 14, 1922. Incision on inner side of arm and forearm; brachial artery and median nerve exposed and retracted; bony prominence removed from lower extremity of humerus. Because of excessive oozing, I did not succeed in taking off as much as was necessary, for the elbow could not be flexed more than 110°. The wound was closed with drainage. A slight infection delayed healing; but by January 30 it was almost closed. Passive motion was begun a few days after operation. When healing was complete, the patient could touch his mouth with the little finger. The roentgenograms, however, showed the coronoid process in contact with the humerus, which prevented complete flexion. It would have been better to remove more bone.

The patient continued under observation for about six months. When I saw him at the end of that period, during the summer of 1922, he could flex the elbow to more than a right angle, and the hand could be held in slight extension with the fingers straight. He was regaining slowly the use of his thumb. But I was not satisfied with the result of the operation

FIG. 1. Lateral view, left elbow, showing deformity four months after supracondylar fracture of humerus. Patient eight years old.

* Submitted for publication June 3, 1929.

FIG. 2.

FIG. 3.

FIGS. 2 and 3. Two weeks after operation, showing lateral view in extension and flexion. Coronoid process of ulna impinges on humerus, preventing complete flexion.

FIG. 4.

FIG. 5.

FIGS. 4 and 5. Same patient nearly seven years later. Lateral view, showing limits of flexion and extension. Use of arm and growth of bone has almost straightened humerus.

on the humerus, and looked forward to further intervention.

I did not see the patient again, however, until November 1928, nearly seven years after operation. Treatment of the Volkmann's contractures had been neglected with resulting atrophy of the forearm, hand and fingers, flexion of wrist to a right angle, and claw fingers. But the extent of flexion of the elbow had increased to almost normal limits. Indeed I was surprised to find how little difference in range of motion there is between this and the right elbow. Extension and flexion are almost complete. Probably there is a difference of 5° in flexion of the elbows. One can feel the coronoid process of the ulna impinging on the humerus; whereas in the normal elbow resistence of soft tissue is noted. Roentgenograms taken November 1928 show the outline of the humerus and the extent of motion (Figs. 4 and 5). Study of these films reveals another important fact. The humerus is almost straight. The angle resulting from the fracture has, in a large measure, been overcome. Probably this is responsible for the increased flexion as much as, if not more, than any other factor. It is not too much to expect that in another seven years, the deformity in the humerus will entirely disappear.

So far as I know, this operation was first performed by Dr. J. M. T. Finney, of Baltimore, more than twenty years ago. He removed the obstructing portion of the humerus. I recall one little patient on whom the result was not satisfactory. This child was anesthetized for a second operation; but after manipulation, it was decided to postpone further interference.

In my patient, exercise and growth overcame the limited flexion, and full range was restored.

In recalling the anatomy of the humerus, one is reminded of the coronoid depression just above the trochlear surface. The bone is quite thin here. I believe the operation described could be improved upon in some cases by reaming a depression for the coronoid process of the ulna after the wedge of obstructing bone has been removed. The healed fracture leaves the bone at this point thicker than normal; and the hollow could be made deep without fear of weakening it. Although the result in the case reported is satisfactory, it might have been obtained earlier had a new bed for the coronoid process been made when the obstruction was removed.

The American Journal of Surgery

Publishing the Transactions of The American Association for the Study of Goiter; The Pacific Coast Surgical Association, The New York Urological Society; Sections of Surgery, Genito-Urinary Surgery and Orthopedic Surgery of the New York Academy of Medicine; Los Angeles Surgical Society, etc.

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EDITORIALS

1930 AN ANNOUNCEMENT 1930

EDITORIALLY 1929 is a thing of the past. We are now concerned with 1930. When we became editor two years ago we were informed we were allowed 100 pages of reading matter an issue. At first we were happy to have that much material on hand. Then, a gradual metamorphosis took place. Manuscripts arrived in increasing numbers. We found we were preparing numbers of THE AMERICAN JOURNAL OF SURGERY months in advance. We discovered we were going over the allotted number of pages until in 1929 the Publishers allowed us to increase the size of THE JOURNAL to 140 pages. Given an inch and taking a yard we often exceeded even this number.

In discussing the Journal for 1930, the Publishers wanted to know what was in store for the future. We informed them that we must have at least 150 pages every month devoted to straight articles, case reports, editorials, Bookshelf Browsing, Biographical Brevities, and Book Reviews. That in addition we were publishing as a supplement from 25 to 35 pages monthly of Dr. Livingston's clinical study of the abdomen and peritoneum. (More of this in the following editorial.)

The Publishers then informed us that they proposed (if we'd agree . . . and we did with enthusiasm) to add 30 to 40 pages each month devoted to the practical, interesting every-day phases of the X-ray, both diagnosis and therapy, this special department to be under the Editorship and direct supervision of Dr. James T. Case, Professor of Roentgenology, Northwestern University, Chicago. This alone insures its success in the widest meaning

of the term. Surgeons and roentgenologists will find this department absorbing because it is designed to be the connecting link between the *x*-ray specialist and the surgeon.

February 1930 will be a Special Number, devoted to Office Surgery. We have arranged for, and have in hand, two score of articles on the various surgical procedures that may be attempted in the office. One would be obliged to look through a mass of surgical literature to get the meat of these short practical articles.

Beginning in January and running through two numbers will be an unique and unusual account of the Alleged Penetration of the Human Urethra by an Amazonian Catfish called Candiru. In March in Bookshelf Browsing is a human interest article by Dr. Warnshuis on Oliver Wendell Holmes.

And so beginning with 1930 you will receive a *newer* and *bigger* and *better* American Journal of Surgery. There have been endless favorable comments on its appearance and it will continue to be a typographical delight. Those articles only will be accepted that are essentially practical, pithy, and of clinical value, articles that the average man working at surgery as a profession will find beneficial and helpful. All phases and branches of surgery will be covered and many unique features included from time to time.

It is apparent that the Publishers cannot give a Journal of 200 pages a month, on the best paper and typographically above the average, for the price of the Journal when it contained only 100 pages of reading matter. We have today the second largest circulation of any surgical journal in the country. Our subscription list is growing by veritable leaps and bounds. The Journal is truly independent. It represents no cliques or schisms. No individual or group can dictate one iota to us. Therefore, we agreed with the Publishers when we had finished outlining this 200 page American Journal of Surgery that to at least in part meet the increased costs the subscription price would have to be increased. This is only common business sense. So, beginning with January, 1930 the subscription price in this country will be $10 per year.

T. S. Welton.

AMERICAN JOURNAL OF SURGERY AND POST-GRADUATE TEACHING

THE medical graduate, upon leaving college and losing intimate contact with teachers, must rely largely upon the written word for further training. Professional journals play an important rôle in supplying such educational material. These periodicals provide a constant flow of information and serve as a continual stimulus.

It is probably not an exaggeration to state that for the average physician there is, from the time of graduation, a steady decline in his knowledge of fundamentals and of medicine as a science. The pressures from practice, human inertia, and economic status are among the factors which contribute to this retrogression.

The few, after perhaps a decade, realizing that they are approaching a mental rut, with effort make it possible to return to a teaching center for a few weeks of postgraduate study. Here, while renewing old acquaintances and mixing other forms of pleasure with their primary object, they observe in the amphitheaters and clinics much of that which is new. They return to their practices stimulated, refreshed, and with a sense of professional rejuvenation.

Not infrequently, however, disappoint-

ment follows. The methods used by the masters fall short in their own hands. The new equipment may, at times, prove little better than the old. An unexpected series of complications and sequaelae is observed. The realization comes that the study given was superficial; that the fundamentals were not acquired. Correspondence, entered upon to augment the training, discloses that the supposedly new technique or apparatus has been superseded; that it was experimental; that it had proved unsatisfactory.

The exceptional few, realizing the dangers from superficiality, make a more sacrificing effort and acquire a longer freedom for study, perhaps one of many months, or even of years. These, as a rule, are medical men who are seeking to alter their course and to vere to some specialty. These fortunate few, with time at their disposal, create affiliations which insure the desired results. Osler testified that his greatest yearning was for "leisure for study." How many desire this, yet how few can attain it!

The real requirements for effective study, whether postgraduate or undergraduate, are that this be largely concerned with fundamentals; that it be leisurely pursued at a rate which is compatible with powers for absorption; and that there be a close correlation between theory and practice. How often does the surgeon wish that he might repeat his course in anatomy or his internship. Knowledge, later acquired, has taught him what things are of most practical moment. It is this constant association of theory and practice which is the secret of strength of the part-time teacher.

Realizing the important influence of a surgical journal and the necessary requirements for effective study, The American Journal of Surgery will attempt in 1930, to fulfill its task more adequately. It will reprint serially throughout the next twelve numbers a textbook titled "A Clinical Study of the Abdominal Cavity and Peritoneum" by Edward M. Livingston. This book is authoritative, scientific, basic, and thoroughly practical. It provides a close correlation between clinical knowledge and the fundamental medical sciences. Reaching the surgeon in limited installments to be read during the pressure of actual practice it must offer an opportunity for sound study and for thorough assimilation of the material. It would seem that somewhere among the 2000 questions which are asked and answered concerning the abdomen there must lie new information and useful facts for any surgeon; that the extensive bibliography must open new channels; that the facsimiles of the writings of Winslow, Murphy, Fowler, Morison, Treves, Trendelenburg, McBurney and others must prove an inspiration to any reader. The Journal feels, in presenting this work, that it is offering a real surgical treat.

Some critics may feel that the work is in parts too elementary for the advanced surgeon; others may feel that it is in other parts too detailed for the busy practitioner: the objection might be offered that the material is given too great space; that new subjects and shorter articles will be crowded out. We feel that the work itself, and the ensuing numbers of The Journal will disarm such critics, providing that they suspend judgment until they have read several installments and have really caught the spirit of the work and the effort of The Journal to fill, in as complete a sense as possible, its field in postgraduate education. T. S. W.

Subscribers to The American Journal of Surgery *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SIR WILLIAM BOWMAN

[1816-1892]

The American Journal of Surgery
N.S. Vol. VII, December, 1929

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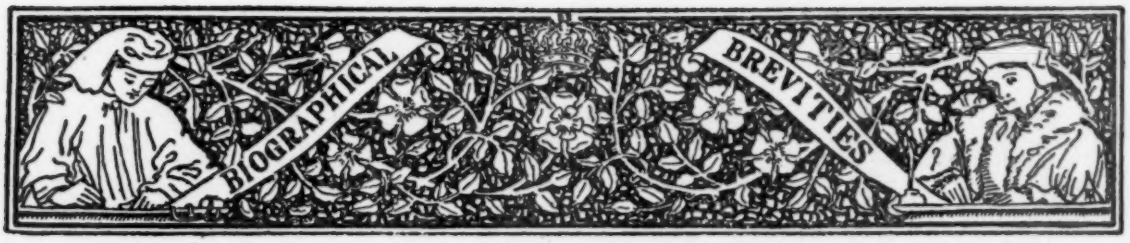

"BOWMAN'S CAPSULE"

SIR WILLIAM BOWMAN was the sum total of the successful physician. He was a true scientist, a clinician of note, a man of scientific avocations, and he died leaving a fortune.

His name brings up the term, "Bowman's capsule" to the student of anatomy. In reality he laid a firmer foundation for enduring fame as an ophthalmologist.

William Bowman was born on July 20, 1816 in Nantwich, Cheshire. His father was a banker whose hobby was botany, and who became a Fellow of the Linnaean Society.

In his youth Bowman studied botany and geology with his father and learned drawing from both parents. He left school at sixteen and became the apprentice of Mr. Joseph Hodgson, a surgeon of the Birmingham General Hospital. The term was for five years.

In his hospital work Bowman made endless notes and recorded "detailed records and drawings of the conditions found."

In 1837, he went up to London, where he became connected with the medical department of King's College as an advanced student. The next year he was advanced to physiological prosector.

In 1838 he visited the medical centers of Holland, Germany, Austria and France. Upon his return he was appointed demonstrator of anatomy and curator of the museum. In 1840 he passed his examination at the Royal College of Surgeons, and in 1844 was elected a Fellow. His rise was rapid. He was made assistant surgeon at King's Hospital, but after a few years gave it up due to the pressure of private practice. However, he did not relinquish his connection with the college. He served as professor of physiology and of general and morbid anatomy and, from 1879 until his death, was a member of the council.

Among his writings were: "The Structure of Striated Muscle," and "The Structure of the Kidney and the Structure of the Mucous Membrane of the Alimentary Canal." In 1843 appeared the first part of his great work, "The Physiological Anatomy and Physiology of Man," the last part being published in 1856. Bowman illustrated many of his writings.

In 1841, because of his researches on the kidney he was elected a Fellow of the Royal Society.

Bowman strove to interest all in the use of the microscope. He has been called "the father of general anatomy in England." His ophthalmic practice became so extensive he gave up all other work and devoted himself to this specialty.

As an ophthalmic surgeon he did brilliant work. In 1847 he delivered the first worthwhile paper on the microscopic anatomy of the eye. He also wrote many other papers on ophthalmology.

In 1867 the University of Dublin conferred upon him the degree of M.D.

In 1876, at sixty years of age, he resigned his position at the Ophthalmic Hospital. A few years later he virtually retired.

In 1884 he was created a baronet. In 1888, as a mark of honor to his useful life, he was given a testimonial in the form of a portrait and the reprinting of his publications.

He married Miss Harriet Paget, the daughter of Thomas Paget, a surgeon of Leicester, in 1842. They had seven children by the union.

In March 29, 1892, he died of pneumonia. He left a personal estate of £103,948, and a reputation which well could be the envy of any man. T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

STALKERS OF PESTILENCE

WADE W. OLIVER, M.D.

BROOKLYN, N. Y.

PART IV

THE NINETEENTH CENTURY

THE first half of the nineteenth century witnessed the definite beginnings of a truly scientific orientation of man's ideas of disease. To a considerable extent this was made possible by refinements in method, by means of which improved microscopes and other instruments of precision were brought to bear upon the age-old mystery of health and disease. Because there was almost a relentless chronological progression in man's attack upon these problems throughout the century, and because, for the first time, public acceptance of hard-won scientific facts did not lag so far behind the discoveries, but often joyfully kept pace with them, it has seemed advisable to write the story of the past century as a more or less continuous narrative, picturing the development of pathology and chemistry, the final overthrow of the doctrine of spontaneous generation, and the rise of the new science of bacteriology and immunology as the unfolding of scientific developments which made the orientation and clarification of man's ideas regarding the nature of disease almost a scientific inevitability. Great human figures arose; old misconceptions tottered and collapsed; and through it all the relentless fingers of the new century were weaving into the warp of the cloth of truth threads of fact supplied by the bound and tramelled hands of scientific workers of the past and by the freer hands of contemporary scientists. And yet, in a century of unprecedented discovery, there were three great scientific figures who, more than any others, influenced and molded the direction of thought upon the nature of disease processes. These three men were the pathologist Virchow, a German, the naturalist Darwin, an Englishman, and the chemist and biologist Pasteur, a Frenchman. This triad affords a most instructive example of how not only diverse nationalities, but different fields of science, collaborated to place man's knowledge of disease upon a sure foundation.

Converging observations and discoveries were at work during the early part of the nineteenth century, preparing the soil in which it was possible for a Virchow to germinate. It was a period of fact-assembling; unbridled theorizing upon the nature of disease such as characterized

the eighteenth century was largely in abeyance; science awaited the accumulation of more exact facts. Contributing to this latter development was the publication, in 1806, of Corvisart's "Essai sur les Maladies et les Lesions Organiques du Coeur et des Gros Vaisseaux," in which he stressed the importance of the study of the pathological changes in the organs as a means of acquiring definite knowledge of the nature of disease processes.

Laënnec. The real genius in this direction, however, was Laënnec (1781–1826) whose "Traité de l'Auscultation Médiate," published in 1822, marks an epoch. It was in 1816 that he conceived the idea of indirect auscultation, out of which the invention of the stethescope developed, an instrument which wrought a revolutionary change in the physician's method of approach to problems of diagnosis. Before Laënnec's time, a physician's examination of a patient was largely subjective; he observed his appearance, felt his pulse, looked at his tongue, examined his urine. Now, for the first time, a really objective examination of organs, particularly those of the chest, was made possible. By comparing his stethescopic findings on the living patient with the post-mortem findings, Laënnec elucidated men's conceptions of various diseases; particularly was this true of tuberculosis. Prior to Laënnec, the early stages of tuberculosis were little known, and, in its advanced stages, it was often hopelessly confused with such chronic pulmonary conditions as bronchitis, empyema, gangrene, etc. Moreover, such medical systematists as Sauvage had listed as many as twenty varieties of pulmonary tuberculosis, basing their conclusions on symptom observation. Laënnec not only showed that all of these so-called varieties were merely stages in one disease, tuberculosis, but he demonstrated that tuberculosis of the lungs is a special disease, differing from other disease processes, and that tuberculosis of other organs, as well as scrofula, were merely manifestations of the same general disease. Laënnec, who died at the age of only forty-five years, was also the first to describe emphysema, bronchiectasis and gangrene of the lungs, as well as to differentiate pneumonia from bronchitis and pleuritis.

Following Laënnec came other outstanding members of the French School, such as Louis, Andral, Bretonneau and others, whose researches led not only to further advances in the knowledge of various diseases, but to continual discoveries of new diseases, as well. As examples may be mentioned Bretonneau's (1771–1862) description of diphtheria, who gave the disease its present name and was the first clinically to differentiate it from scarlet fever, and his classic demonstration of the specific character of different diseases, contained in his book which appeared in 1826; and Louis' and Andral's pioneer studies on typhoid fever. From Paris, the clinical-scientific revolution initiated by the French School led to the development of similar clinical schools in England and Ireland and Germany and America. In Dublin, from 1820 on, arose such physicians as Graves, Cheyne, Stokes, Adams and Corrigan; in London such pioneers as Addison and Bright, in Germany, Skoda and Rokitansky, and in America such medical figures as Gerhard. With all of them, emphasis was placed on the importance of a combination of anatomical-pathological-clinical investigation in elucidating the nature of disease processes. As Graves expressed it in one of his clinical lectures:[49]

> In order justly to estimate the importance of morbid anatomy, we should recollect that the first alteration in the picture of a part is not the cause but the consequence of disease . . . Thus the physical alterations which attend external inflammation, the tumefaction, the heat, the redness are not the cause but the consequences of disease. But in thus reducing them to the rank of symptoms, do we diminish their importance? Certainly not. For being immediately connected, as effects, with the *primary* cause, they prove the most useful of all symptoms, in enabling us to ascertain the seat and progress of diseased action.

Now, stimulated by the French physiologist Magendie, there arose what has been called the School of German Physiological Medicine, which postulated that pathological phenomena are merely modified physiological phenomena, and that, therefore, the complete elucidation of the nature of disease processes is to be obtained not merely by a study of the changes in the various organs after death, but by experimental physiology as well. Members of this School include such distinguished names as those of Schwann, Remak, Wunderlich, Henle, Traube, Frerichs, Virchow, Helmholtz, du Bois-Reymond, etc. Wunderlich, in his "Geschichte der Medizin" (1869), clearly defines the reason for his insistence on the name "physiological medicine:"

> On the one hand, it was chosen to express the fact that pathology, in contrast to all ontological and personifying conceptions, is only the physiology of diseased man; on the other hand, to call to mind the fact that pathology requires the same means and methods to establish facts, and the same logic in argumentation, as were already recognized in the science of healthy man.

And Virchow, in his famous treatise "Die Einheitsbestrebungen in der wissenschaftlichen Medizin" (1849) wrote: "The subjects of therapy are not diseases but conditions; we are everywhere concerned only with changes in the conditions of life. Disease is nothing but life under altered conditions." The great advance of the German Physiological School of Medicine lay in the fact that it stressed the absolute importance of learning the relations between pathological phenomena, whereas the French school had confined itself largely to a minute description of the clinical and pathologico-anatomical phenomena of disease processes.

Just as Bichat, earlier in the nineteenth century, marked an epochal advance by his general anatomy, so Virchow, through his cellular pathology and his proof that all cells come from parent cells, as well as by his cellular studies on such diseases as tuberculosis and tumors, became a pioneer in turning the direction of medical and scientific researches towards the cell, as constituting the ultimate basis from which knowledge of both health and disease are to be derived.

Rudolph Virchow (1821–1902), who is quite generally regarded as the greatest pathologist the world has ever known, was born in Schievelbein, Pomerania. He graduated in Berlin in 1843, and in 1847 he and Reinhardt founded the *Archiv für pathologische Anatomie und Physiologie und für klinische Medizin*, which even today is the leading journal of pathological anatomy in the world. In 1846 appeared Virchow's classic researches on thrombosis and embolism; then followed his no less classic work on pyemia and inflammation, his discovery of leucemia, his pioneer investigations on degenerations, and his researches on the specific cellular constituents of tumors. But the great, outstanding contribution of Virchow was that he rebuilt the science of pathology, making it a cellular pathology, in place of the previous science in which cells had no part. It is to him that the scientific world owes its conception of the human body as being an organized, and continually developing, cell state, in which each microscopic unit, or cell, plays its part; a conception which has done much to clarify men's ideas of not alone inflammations, degenerations, etc., but of tumors as well. It was Virchow who taught pathologists to look to the cell as constituting the microscopic field in which the ravages and the telltale marks of disease are best to be read, a lesson made possible largely by marked improvements in microscopes which were made during the first half of the nineteenth century.

Coincident with these advances, new methods, microscopical, mechanical and chemical, were introduced into clinical medicine, and thereby contributed to a further elucidation of the nature of certain disease processes. As early as 1843, Andral published his "Essai d'hematol-

ogia," in which, among other innovations, he described methods for determining the amount of fibrin and of corpuscles in the blood, and of albumin in serum, by weight; studies which laid the foundations of hematology. Again, in 1852, Vierordt, a physiologist, introduced methods for counting blood cells, and in 1855, he employed the sphygmograph for studying the pulse. Helmholtz, another physiologist, invented the ophthalmoscope in 1850; and Trommer and Heller, physiological chemists, introduced chemical methods for the study of the urine. And in France, during this period, the great physiologist Claude Bernard was continuing his researches in experimental physiology, out of which resulted such monumental contributions to science as his studies on the nature of glycosuria, on pancreatic digestion, and on the circulatory and heat-regulating mechanisms of the body. Indicative of his attitude toward science, Claude Bernard once said:

> Put off your imagination, as you take off your overcoat when you enter the laboratory; but put it on again as you do your overcoat, when you leave the laboratory. Before the experiment, and between whiles, let your imagination wrap you around; put it right away from you during the experiment itself, lest it hinder your observing power.

While these developments in pathology and chemistry were transpiring, certain important technical advances were made possible by improved microscopes, and there occurred a greater centering of attention upon the hitherto little known bacteria. Coincident with these discoveries relating to microscopic life, the inevitable battle over the doctrine of spontaneous generation flared up anew. We find that the year 1835 assumes importance because that year was signalized by improvements in the achromatic lens and by the perfection of the Abbe condenser, and very shortly important fruits of these technical advances appeared. In 1837, Latour, Schwann and Kutzing independently studied the microscopic yeast cells in fermenting beer and wine, cells previously seen by Van Leeuwenhoek and named *Mycoderma cerevisiae* by Desmazieres. In the same year Agostino Bassi (1773–1856), an Italian, investigated a contagious disease of the silkworm known as muscardin, and showed that the disease was transmitted by the passage from infected to healthy worms of minute, glittering particles (spores) of a minute plant, a yeast subsequently renamed *Torula cerevisiae* by Turpin. Bassi prophesied that just as he had shown the relation of a certain type of microorganisms to a disease of silkworms, so would animal or vegetable microbes be discovered some day to be the cause of such human diseases as smallpox, plague and syphilis.

During this time, Franz Schulze, in 1836, and in 1837 Theodor Schwann, the founder of the cell theory, turned their attention to the doctrine of spontaneous generation. They repeated the experiments of Needham and Spallanzani, directing particular attention to the troublesome oxygen factor introduced by Priestley's discovery.

Schulze employed a flask containing nutrient fluids, plugged with a large perforated cork through which connections were made by means of bent glass tubes with a series of bulbs containing sulphuric acid and other acid solutions. By means of an aspirator, air was sucked through the acid, in order to remove the floating germs in the air, before the air reached the culture flasks. Schulze found that when such chemically purified air was drawn into flasks containing previously boiled nutrient fluids, the culture media remained sterile, although the air drawn into the flasks contained unaltered oxygen. Tyndell,[50] commenting on these experiments, says:

> Here again the success of Schulze was due to his working in comparatively pure air, but even in such air his experiment is a risky one. Germs will pass unwetted and unscathed through sulphuric acid unless the most special care is taken to detain them. I have repeatedly

failed, by repeating Schulze's experiments, to obtain his results. Others have failed likewise. The air passes in bubbles through the bulbs, and to render the method secure, the passage of the air must be so slow as to cause the whole of its floating matter, even to the very core of each bubble, to touch the surrounding fluid. But if this precaution be observed water will be found quite as effectual as sulphuric acid.

Schwann (1837) used an apparatus somewhat similar to Schulze's, except that he drew the air for his culture flasks through a bent tube surrounded by a jacket of highly heated metal, thereby obtaining a germ-free air through high heating, rather than by washing the air in acid. He, likewise, reported that his flasks of media remained sterile.

Objections were still raised against the experiments of both Schulze and Schwann, mainly on the basis that the oxygen admitted to the culture flasks might be changed in its properties through passage through acid, and by extreme heat, thereby rendering it unable to support life. Schroeder and Dusch, in 1854, met this objection by showing that sterilized culture media in flasks plugged merely with cotton, which allowed of ingress of chemically and physically unaltered air, remained sterile if proper precautions in sterilization were observed.

In 1838 Ehrenberg, employing improved microscopes, introduced a classification of microscopic microorganisms which is employed, with minor modifications, at the present time. He introduced the term *Vibriones* to include the microscopical forms, which he subdivided into four species: (1) the rigid filamentous bacterium, (2) the flexuous filamentous vibrio, (3) the rigid filamentous spirillum and (4) the flexuous filamentous spirocheta. In 1839, the parasites of favus and thrush were observed.

In 1840, Jacob Henle, the distinguished anatomist, after a careful weighing of the evidence, concluded, in his "Pathological Investigations," that there is a causal relationship between the minute, living microorganisms or fungi and disease. Because of the fact that he not only collected and adjudged the work of previous investigators, but also rigorously investigated the subject himself, Henle has been termed the real propounder of the Germ Theory of Disease. With the relatively crude methods at his disposal, he was unable to satisfy the requirements he formulated as being essential to the proof of the theory, requirements, incidentally, which he so ably formulated that they are almost identical with the postulates laid down by Koch, years later, as being necessary of fulfillment before a definite relationship can be established between a given microorganism and a given disease.

As Ford[51] says: "The year 1840 may be said to mark the beginning of the modern science of bacteriology."

In 1840, Felix Dujardin, using microscopes with a magnification of from 300 to 1200 diameters, described microorganisms in such conditions as favus, herpes tonsurans, pityriasis versicolor and soor, as well as in typhoid ulcers and in the nasal secretions of glandered horses. His observations, as well as those of his contemporaries, were made on unstained fluid preparations, or on preparations stained by carmine and indigo. In 1842, Goodsir, the Scotch surgeon, discovered *Sarcina ventriculi* in stomach contents, and in 1843. Oliver Wendell Holmes, the distinguished New England physician, poet and essayist, published his classic "Contagiousness of Puerperal Fever." Four years later, in 1847, Semmelweiss, of Vienna, announced his belief that puerperal fever depended upon poisons carried by the fingers of physicians and students to the woman in childbed.

In 1849 Pollender, and in 1850 Davaine, described the anthrax bacillus in the blood of animals dying, and dead, of anthrax, but were very conservative in the matter of attributing etiological significance to the microorganism; and in 1853 Delafond produced anthrax in animals and showed

that only when anthrax bacilli are present in the blood is such blood experimentally infective for healthy animals.

In 1854, Schroeder and von Dusch introduced the use of cotton as air filters in flasks and test tubes, showing that dry cotton plugs prevent the entrance of air microorganisms into previously sterilized receptacles.

The world of science was on the threshold of monumental discoveries; and now enters upon the stage Darwin, the immortal activator.

Darwin. There have been few books in the history of the world that have caused a more profound revolution in men's thoughts than Darwin's "Origin of Species," published on November 24, 1859. Charles Darwin (1809–1882) was born at Shrewsbury, England, where his early education was obtained; later he matriculated at Cambridge, where he graduated in 1831. An intensely human sidelight upon the ill-health with which Darwin was inflicted is afforded by the following words written by his son Francis:[52]

> No one indeed, except my mother, knows the full amount of suffering he endured, or the full amount of his wonderful patience. For all the latter years of his life she never left him for a night; and her days were so planned that all his resting hours might be shared with her. She shielded him from every avoidable annoyance, and omitted nothing that might save him trouble, or prevent him becoming over-tired, or that might alleviate the many discomforts of his ill-health. I hesitate to speak thus freely of a thing so sacred as the life-long devotion which prompted all this constant and tender care. But it is, I repeat, a principal feature of his life that for nearly forty years he never knew one day of the health of ordinary men, and that thus his life was one long struggle against the weariness and strain of sickness. And this cannot be told without speaking of the one condition which enabled him to bear the strain and fight out the struggle to the end.

The full title of Darwin's masterpiece was "On The Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life." The almost immediate effect of this book upon scientific minds was one of liberation; the previously hidebound, conventional view that natural events, including disease, moved in immutable channels lost its attractiveness; daring vistas began to open in the thoughts of men. For static immutability was substituted the rejuvenating concept of perpetual flux. Time-honored classifications of diseases, based upon superficial resemblances, began to be doubted; suddenly the minds of medical men were stirred with the thought that not only are diseases phases of the flow of natural processes operative throughout the living universe, but hope began to be born that it might be possible for science to pierce to the actual origins of disease, instead of merely cataloging its manifestations and ravages in the body. Moreover, the "Origin of Species," with its first five chapters which explained artificial selection and the operation of natural selection because of the struggle for existence, as well as the laws of variations and the causes of modifications, centered scientific minds upon heredity and the possible heredity of certain diseases.

Fortunately for the cause of medical science, Darwin's "Origin of Species," and the multiplicity of speculations to which it immediately gave birth, appeared at the time when not only were experimental methods being rapidly perfected, but even more important the great, liberating figure of Pasteur was looming upon the scientific horizon.

The proper introduction to Pasteur is best made by picking up the threads of the controversy over spontaneous generation which, as we have seen, received a temporary new lease of life in the early part of the nineteenth century. This largely resulted from the fact that widely divergent ideas in regard to the nature of fermentation were held at this time. Berzelius, the Swedish chemist, believed that fermentation resulted from a catalytic force, i.e. by contact. He dismissed the

yeast cells, described by Latour in fermenting beer and wine, by saying that what Latour had seen was but "an immediate vegetable principle, which became precipitated during the fermentation of beer and which, in precipitating, presented forms analogous to the simpler forms of vegetable life, but formation does not constitute life." Liebig, the German chemist, believed that the ferment itself came from dead protein materials. In contrast to Berzelius' theory of "contact," Liebig taught a theory of "influence;" and these two theories of fermentation reigned almost supreme in the early 50's of the nineteenth century.

Now into the lists steps a Frenchman, Pouchet, director of the Natural History Museum of Rouen, whose main bid to fame lies in the fact that he was the activator of Pasteur's monumental experiments on the nature of fermentation. On December 20, 1858, Pouchet sent to the Acadèmie des Sciences a "Note on Vegetable and Animal Proto-organisms Spontaneously Generated in Artificial Air and Oxygen Gas." An index to his false mental approach is vouchsafed by the following opening sentence from his book on Heterogenesis: "*When, by meditation,* it was evident to me that spontaneous generation was one of the means employed by nature for the production of living beings, I applied myself to discover by what means one could place these phenomena in evidence." In his note to the Academie Pouchet, after insisting on the excessive precautions he had taken to exclude all sources of error in his experiments, declared that he was prepared to demonstrate that "animals and plants could be generated in a medium absolutely free from atmospheric air, and in which, therefore, no germ of organic bodies could have been brought by air." The crucial experiment performed by Pouchet was as follows: After filling a flask with boiling water and carefully sealing it, he inverted it and thrust the neck into a bath of mercury. When the water had cooled, he opened the neck of the flask, still under the mercury, and connected it with an oxygen-liberating retort. By heating the retort, he bubbled oxygen into the flask, thus replacing some of the water. When about half of the water was displaced by oxygen, Pouchet took a small amount of hay, previously heated in an oven to a high temperature, and pushed the hay, grasped in a pair of sterile forceps, underneath the mercury and into the mouth of the flask. Thus he produced a hay infusion in contact with pure oxygen. After a few days' incubation, the infusion became cloudy and, under the microscope, it was found to be teeming with microorganisms.

In introducing the experiment described, Pouchet wrote:

> The opponents of spontaneous generation assert that the germs of microscopic organisms exist in the air, which transports them to a distance. What, then, will these opponents say if I succeed in introducing the generation of living organisms, while substituting artificial air for that of the atmosphere?"

And, at what he considered the triumphant conclusion of his experiment, he wrote:

> Where does this life come from? It cannot come from the water which had been boiled, destroying all living germs that may have existed in temperature of incandescence. It cannot have been carried in the hay, which had been heated for a long period before being introduced into the water.

Therefore, Pouchet declared this life in his flask to be of spontaneous origin.

Pasteur. Now is the stage set for the entrance of Louis Pasteur. Born on December 27, 1822, in an humble house in Dole, France, his father a tanner and a sergeant in the 3rd Regiment of Napoleon, his mother the daughter of an humble gardener of Marnoz, the boy gave no particular indication of the brilliant career that was to be his as a man. When, at the age of twenty, he went up for his examination for the *Baccalaureat des sciences* before the Dijon Faculty he was only put down as "mediocre" in chemistry. And when, a

few weeks later, he took his examinations for the École Normale, he passed only fifteenth out of twenty-two candidates. However, the following year he was admitted fourth on the list.

His first scientific recognition came to Pasteur in the fields of chemistry and molecular physics, in which he had pursued researches from the time he left normal school. He showed that crystals of certain tartrates, chemically and physically similar except in the fact that they each had their special hemihedral facets, acted differently when their solutions were examined under a polariscope. In his own words:[53]

I separated with care the right and left handed hemihedral crystals and observed separately their solutions in the polarization apparatus. Then, with no less surprise than joy, I saw that the right-handed hemihedral crystals turned to the right and the left-handed ones to the left the plane of polarization, and when I took equal weights of each of these kinds of crystals the mixed solution was neutral to polarized light because of the neutralization of the two equal and opposite individual deviations.

From these, he proceeded to study the aspartates and malates and, as Duclaux says:[54] "Thus, little by little, was born in his hands the science of the arrangement of atoms (stereochemistry), which has since attained so much importance. Wherever he went Pasteur was an initiator."

One day, in 1853, Pasteur said:[55]

The Universe is a dissymmetrical whole. I am inclined to think that life, as manifested to us, must be a function of the dissymmetry of the universe and of the consequences it produces. The universe is dissymmetrical, for if the whole of the bodies which compose the solar system were placed before a glass moving with their individual movements, the image in the glass could not be superposed to the reality.

And again: "Life is dominated by dissymmetrical actions; I can even foresee that all living species are primordially, in their structure, in their external forms, functions of cosmic dissymmetry." All of his life Pasteur retained a regret that he was not able to complete his studies on crystallography. At the age of seventy, he said:

If I have a regret, it is that I did not follow that route, less rude it seems to me, which would have led, I am convinced, to wonderful discoveries. A sudden turn threw me into the study of fermentation, fermentations set me at diseases, but I am still inconsolable to think that I have never had the time to go back to my old subject.

In 1857, Pasteur went to Paris as director of scientific studies in the École Normale, and there, in an uninhabitable garret, he pursued his studies on fermentation which culminated in the following brilliant demonstration:

Fermentation is no longer a vague transformation, indeterminate in its cause and in its origins, capable of taking place under the influence of any organic substance whatsoever; it is a specific phenomenon, due also to the existence and development of a specific organism, the study of which under the microscope is facilitated in proportion as we remove from the liquid undergoing fermentation those insoluble organic substances which it was formerly believed necessary to add to it. Since, by working with a clear bouillon, it is possible to follow closely the organism sown, and to be sure that the bouillon contains this and this alone, the study of its nutrition becomes easy. Now, by acting on the nutrition of an organism, we become the master of it; we can sow it and cultivate it with as much certainty, and with the same absence of weeds, as we can cultivate lettuce in a garden. We can also banish it from liquids where there is no occasion for its presence. In short, this infinitely small organism becomes tangible, and open to experiment; a capital idea which the whole life of Pasteur will henceforth be spent in developing.[56]

In his article on lactic fermentation, Pasteur[57] showed that fermentation is a vital act, brought about by a yeast; he advanced the idea of a specific, living ferment for each fermentation, and ended with these words:

It is now my opinion as the result of the knowledge that I have gained on this subject, that whoever will judge impartially the results of this work and those which I shall study in the near future, will recognize with me that fermentation is correlative with life, with the organization of globules, not with the death or putrefaction of these globules; neither does it appear to be a phenomenon of contact where the transformation of the sugar takes place in the presence of the ferment without giving anything to it or taking anything from it. These latter affirmations, one will soon see, are contradicted by experiment.

In 1860, Pasteur[58] demonstrated that both lactic fermentation (the souring of milk) and alcoholic fermentation are due to the growth of microscopic organisms. His crucial experiment consisted in growing the yeast in a liquid deprived of all nitrogenous organic matter, one containing only pure cane-sugar, various mineral salts, and an ammonia salt to supply the cells with nitrogen. In this medium the yeast cells developed, and multiplied, and caused fermentation. Thus not only was Liebig's theory of fermentation demolished, which claimed that organic nitrogenous matter was necessary for fermentation to occur, but that of Berzelius as well, which postulated that the ferment exerted its action only by its presence (catalysis), remaining unchanged in quantity and quality throughout the process.

Pasteur had now demonstrated that ferments are living beings, and that for each kind of fermentation there is a special corresponding ferment. At this time (1860) we find him writing in a letter to his father: "God grant that by my persevering labours I may bring a little stone to the frail and ill-assured edifice of our knowledge of those deep mysteries of Life and Death where all our intellects have so lamentably failed."

From now on we find Pasteur embarked on that long, brilliant series of biological experiments which were to culminate in his triumphant proof of the germ-causation of so many diseases of man and animals. In the early 1860's, Pasteur studied butyric fermentation and, much to his surprise, discovered that the butyric ferment, which is responsible for the bad odor in rancid butter, was a motile vibrio, a bacterial cell, in contrast to the non-motile plant (yeast) cells which he had found to be the cause of lactic and alcoholic fermentation. He writes:

But, by a strange phenomenon, those infusory animalculae live and multiply indefinitely without requiring the least quantity of air. And not only do they live without air, but air actually kills them. It is sufficient to send a current of atmospheric air during an hour or two through the liquor where those vibriones were multiplying to cause them all to perish and thus to arrest butyric fermentation, whilst a current of pure carbonic acid gas passing through that same liquid hindered them in no way.

Afterwards, Pasteur called those microorganisms which do not require, and are even inhibited by atmospheric air, anaerobes.

Now, also, is Pasteur engaged (1859–1864) in his classic series of experiments to disprove Pouchet's assertations in regard to spontaneous generation. A year before starting discussion, Pasteur writes to Pouchet:

I think you are wrong, not in believing in spontaneous generation (for it is difficult in such a case not to have a preconceived idea), but in affirming the existence of spontaneous generation. *In experimental science it is always a mistake not to doubt when facts do not compel affirmation.*

After a year's study, Pasteur came to the conclusion that the germs which developed in Pouchet's flasks came from the air. "Impossible!" retorted Pouchet. Pasteur had studied the atmospheric air by aspirating a current of air into a tube through a little plug of cotton wool. He had found that such filtered air did not cause growth in a tube containing culture media, but if a small fragment of this cotton wool through which air had been drawn was dropped into a tube of sterile media, prompt growth of microorganisms took

place, due to germs and spores deposited on the filter. Then, because objection was raised on the ground that the cotton wool was an organic substance, Pasteur substituted for it asbestos fiber, a mineral substance, with the same results. Then Pasteur invented little glass flasks with long, curved necks; he found that if these flasks were filled with sterile media no growth occurred, because the germs from the air were deposited in the curve of the flask's neck and there remained, without touching the liquid. But if the liquid in the flask was tilted up so as to wash into it some dust which had collected on the neck, then microorganisms developed in the media. Pasteur went farther, literally and figuratively. During his vacation, in August and September of 1860, he set out, armed with seventy-three glass flasks with which to test the air on heights and in places far from habitation. As Valery Radot[59] so graphically remarks:

> Pasteur started for Arbois, taking with him seventy-three flasks; he opened twenty of them not very far from his father's tannery, on the road to Dole, along an old road, now a path, which leads to the mount of the Bergere. The vine labourers who passed him wondered what this holiday tourist could be doing with all those little phials; no one suspected that he was penetrating one of nature's greatest secrets. "What would you have?" merrily said his old friend Jules Vercel; "it amuses him!"

Of these twenty flasks which he opened, and then carefully sealed, eight showed growth. Then on through France he went and up into the Alps, where on the glacier Mer de Glace, above Chamonix, he exposed to the air twenty flasks, all but one of which remained sterile. In speaking of this journey twenty years later, Pasteur said: "If all the results are compared that I have obtained until now, it seems to me that it can be affirmed that the dusts suspended in atmospheric air are the exclusive origin, the necessary condition of life in infusions."

In the summer of 1863, Pouchet and two associates, Joly and Musset, decided to repeat Pasteur's experiments. So, armed with four phials containing a hay infusion, they climbed to a narrow crevasse at the foot of one of the greatest glaciers of the Maladetta, 3000 meters above sea-level, where they opened, and then carefully sealed their flasks. Triumphantly, they asserted that all their flasks showed growth. Discussion waxed so warm that the Academy of Sciences, at the solicitation of Joly and Musset, appointed a Commission, before which the scientific adversaries could wage their battle of experiments. So, on April 7, 1864, before a brilliant audience at the Sorbonne, for not only scientists, but the public as well, were admitted, Pasteur met the objections advanced by Pouchet, detailed his own experiments, and, amid enthusiastic acclaim, really sounded the death knell of the theory of spontaneous generation.

Now Pasteur returns to his sduy of wines, and in January 1864, he announces to the Acadèmie des Sciences: "I have indeed reached this result that the alterations (diseases) of wine are co-existent with the presence and multiplication of microscopic vegetations." Moreover, he found that keeping wine at a temperature of 50° to 60°C. for a few minutes killed these harmful germs, and thereby prevented the wine from becoming bitter, sour or "ropy." (See his Ètudes sur le vin, 1866.)

The next year, 1865, marks the definite orientation of Pasteur's scientific energies into pathology and medical bacteriology. For from then until 1870, he devoted the major portion of his time to a study of pebrine, an epidemic disease of silkworms that was raging in such terrible proportions that it threatened to ruin the silkworm industry of France, and to flacherie, another disease of silkworms. He demonstrated the contagious nature of pebrine and showed that contagion occurred either directly from infected to healthy silkworms on the same frame, or through soiling of the silkworm's food by the very infectious

excreta of the diseased worms; in addition, Pasteur worked out a rather simple method for preventing the spread of the infection. Moreover, he showed that the "corpuscle," or germ, of pebrine is transmitted in the eggs of infected female worms.

During this period of his researches, on October 19, 1868, at the age of forty-six years, Pasteur suffered an alarming cerebral hemorrhage, which caused a paralysis of the entire left side of his body. "I am sorry to die," he said, "I wanted to do much more for my country." After a few months of convalescence, he was once more haunting his laboratory. New discoveries were fermenting in his brain; he was forever saying: "We must get to work!" Yet discoveries which he had already made were even now beginning to revolutionize medical and surgical practice. Joseph Lister (1827–1912), the Scotch surgeon to whom the world owes the introduction of aseptic methods into surgery, frankly acknowledged his debt to Pasteur in an address which he gave before the British Medical Association in Dublin in 1867.

> When it had been shown by the researches of Pasteur that the septic property of the atmosphere depended, not on oxygen or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that decomposition in the injured part might be avoided without excluding the air, by applying as a dressing some material capable of destroying the life of the floating particles.

The material he employed was carbolic acid, which was used not alone for disinfecting the surgical instruments, sponges, etc., but was used on the operator's hands; during the whole course of the operation, a vaporizer of carbolic solution sprayed the atmosphere over and around the wound, and after the operation was over, the wound was again washed with the carbolic solution.

From now on, until his death in 1895, Pasteur's researches were largely devoted to problems relating to the cure and prevention of disease. It is interesting to note, however, that his later discoveries, which represent his supreme service to mankind and which did so much to bring to light the actual bacterial causes of various plagues and pestilences and fevers which for so many generations had scourged the human race, followed logically and almost inevitably from his earlier studies. Particularly is this true of his studies upon the nature of fermentation, and the coincident knowledge which he had gained of the morphology and physiology of microorganisms.

One of the first animal, and secondarily human, diseases which Pasteur studied was anthrax. The bacterial cause of this disease, Bacillus anthracis, was discovered in 1849 by Pollender, and in 1850 by Davaine, in the blood of cattle suffering with anthrax. In 1853 Delafond showed that the disease could experimentally be transmitted to healthy cattle by the injection of anthrax blood which contained the bacterium. It was not, however, until July 1876, that a young country physician in Wollstein, Germany, Robert Koch (1843–1900) by name, published his classical article on anthrax.[60] In this communication, he reported having worked out the complete life-history of the anthrax bacillus, and in it he showed that the nature and distribution of the disease could be fully explained by the mode of development of the causative microorganisms, particularly their sporulation. This alone was a great contribution, this proof of sporulation by the anthrax bacillus and this complete elucidation of its life cycle. But there was still more! Koch reported that he had grown the anthrax bacillus in pure culture, unmixed with bacteria of any other kind, by employing hanging drops of aqueous humor and sterile blood serum placed over hollow ground slides; and by the use of pure cultures grown for a number of generations outside of the infected animal body he reported that he had produced anthrax in mice, guinea pigs and rabbits. A

monumental piece of scientific investigation, this; for the first time in the history of the world a disease producing bacterium had been artificially grown in a pure state outside of the infected animal body, and the specific disease produced in healthy, different animals by injecting a pure culture of the bacterium into their bodies. In November 1877, Koch published a second paper in which he described his method of making smears of bacteria on cover-slips, fixing them by drying or gentle heat, and staining them with aniline dyes, which Weigert previously had employed for the demonstration of bacteria in tissues. In addition, he described a method for staining the flagella of bacteria.

Koch's studies led Pasteur to a study of anthrax and other infectious diseases to which, as Pasteur himself said at the time, "I have thus far been a stranger." Pasteur confirmed Koch's findings, and then went on to study another septicemic disease, known as malignant edema, a disease common to man and domestic animals, with the resultant discovery, in 1877, of the Vibrion septique, an obligate anaerobe. In this same year, Patrick Manson (1844–1922), "the father of tropical medicine," discovered the phenomenon of filarial periodicity in the circulating blood of man; while four years earlier, in 1873, Obermeier had demonstrated the Spirochaeta recurrentis in the blood of patients in the febrile stages of relapsing fever.

In 1879 Pasteur began his studies on chicken cholera, a disastrous disease of the chicken yard; this year was further signalized by Hansen's (1841–1912) discovery of B. leprae[61] in leprous nodules and Neisser's (1855–1916) discovery of the gonococcus in gonorrheal secretions.[62]

The year 1880 was a memorable one. Eberth (1835–1926) discovered B. typhosus,[63] the cause of typhoid fever; Laveran[64] (1845–1922), while working at the Military Hospital of Constantine in Algeria discovered the Plasmodium malariae, the cause of malaria; and in the same year Sternberg (1838–1915) and Pasteur independently discovered the pneumococcus. Moreover, it was in 1880 that Pasteur[65] laid the cornerstone of the science of immunology by his discovery of protective vaccination against chicken cholera, a discovery, incidentally, which arose from a purely accidental occurrence. Pasteur had made some cultures of the bacillus of chicken cholera; then he was called away from the laboratory for several months. On his return, he found that his cultures, which had been standing on his desk for several months at room temperature and without transplantation, no longer killed healthy chickens upon injection, as previously they had done. Now they gave rise only to localized, non-fatal lesions. From this observation, Pasteur developed a method of protective vaccination against chicken cholera, by injecting first a *premier vaccin* of a very much attenuated or weakened culture of the microorganism, followed after twelve or fourteen days by a second, less attenuated culture (*deuxième vaccin*). This was followed, in 1881, by Pasteur's clear-cut demonstration that anthrax vaccine is effective in the immunization of cattle against anthrax, or splenic fever. In this instance, he prepared his vaccine from a culture grown in a shallow layer of neutral chicken broth, the bacilli being attenuated, and spore formation prevented, by growth at 42–43°C. As Adami once said: "That a plague of diarrhea in a poultry yard, studied by a professor of chemistry, should be the seed from which has grown the vast development of later years is a strange fact, but fact, nevertheless."

In 1881, Koch[66] described his greatest technical achievement, the discovery of the pour-plate method for the isolation of bacteria in pure culture. Up to this time, no certain method had been available for obtaining pure cultures of microorganisms from mixtures. Koch employed nutrient gelatin in such proportions as to give a semisolid medium when cooled. To obtain pure cultures, he advised direct inoculation of the previously melted and then cooled

gelatin, shaking it well to separate the individual cells, and then pouring of the gelatin over the surface of a sterilized glass dish.

Now that Koch had supplied correct methods for the recognition and cultivation of the exciting agents of infectious diseases, discoveries came "as easily as ripe apples fall from the tree," as Koch himself expressed it. In 1882, Koch[67] reported his discovery of the tubercle bacillus, the cause of tuberculosis; in the same year Friedrich Loeffler (1852–1915), one of Koch's students and associates, discovered B. mallei, the cause of glanders.

The full account of Koch's experiments and deductions upon tuberculosis was not published until 1884.[68] It was in this communication that Koch first formulated in print the famous postulates known by his name, postulates which should be fulfilled before a given bacterium can positively be regarded as the cause of a given disease. Briefly, Koch's Postulates are: (1) the parasite must be found in every case of the disease, and under conditions which explain the pathology and clinical behavior of the disease; (2) the parasite must not be found as an accidental harmless invader in other diseases, and (3) a pure culture of the parasite, when introduced into the body of another animal, should be recovered from the diseased tissues of the experimentally infected animal. In this same communication, Koch published two ideas which later he had to withdraw: (1) that the small, refractile bodies found in the tubercle bacillus are spores, and (2) that tuberculosis of man and animals is identical, and is caused by an identical bacillus.

In 1883 Koch[69] discovered the cholera vibrio, the cause of Asiatic cholera, thus pointing the way to quarantine and control of this deadly scourge of the tropics. This work was done while Koch was the head of the German Cholera Commission, first in Egypt and later in India. In 1884, Loeffler[70] isolated in pure culture, B. diphtheriae, the cause of diphtheria, first seen by Klebs[71] one year earlier.

At this time (1884) Madame Pasteur wrote to one of her children: "Your father is absorbed in his thoughts; talks little, sleeps little, rises at dawn and, in one word, continues the life I began with him this day thirty-five years ago." In 1885, in collaboration with Chamberland, Roux and Thuillier, appeared Pasteur's crowning discovery of preventive vaccination against hydrophobia. This resulted in the formal opening of the Pasteur Institute in Paris on November 14, 1888, contributions to which had poured in from all over the world. In the Institute, which Pasteur entered weary and ill, he remained as director until his death on September 28, 1895.

In 1885, Nicolaier[72] discovered B. tetani, and four years later Kitasato[73] first cultivated this microorganism in pure culture. In 1887, Weichselbaum[74] first cultivated the meningococcus in pure culture, and in the same year Bruce[75] first described B. melitensis, the cause of Malta fever.

Coincident with the demonstration that in many of the infectious diseases the pathogenic or disease-producing agents are specific bacteria, it was a natural development of the science of bacteriology that attention should be centered upon the mechanism by means of which bacteria incite destructive changes in the body, as well as upon the methods by means of which the body combats bacterial invasion. A tremendous stimulus to this quest was afforded in 1888 by two of Pasteur's pupils, Emile Roux and Alexandre Yersin,[76] who made the amazing discovery that if the diphtheria bacillus is grown in broth, and the broth filtered, the bacterium-free fluid is not alone highly toxic, but the toxin is specific, because the injection of this fluid into an experimental animal such as a guinea pig sets up in the animal the characteristic lesions of diphtheria. At almost the same time, Kitasato[77] discovered the presence of a specific toxin in a broth culture of the tetanus bacillus, from which the bacteria had been removed by filtration. In 1890, Behring (1854–1917)

and Kitasato,[78] working in Koch's Institute, made their classical discovery that the blood serum of rabbits immunized with tetanus toxin developed antitoxic properties, *i.e.* the blood serum developed the capacity to so neutralize tetanus toxin that amounts of toxin which ordinarily would prove fatal could now be injected into such animals with impunity. Moreover, if such an immunized animal was bled, and its blood serum injected into another animal, this second animal would likewise be protected against tetanus toxin. Almost simultaneously, Behring[79] and his associates discovered diphtheria antitoxin, and in 1894 diphtheria antitoxin was introduced as a therapeutic agent in the treatment of diphtheria in man.

It soon became evident that diphtheria and tetanus constitute a group of rather special diseases, whose symptoms can experimentally be reproduced by the soluble, poisonous products (exotoxins) of the causative microorganisms, and in which immunity is due to the development of specific anti-substances (antitoxins) capable of neutralizing the toxins. The majority of infectious diseases do not fall in this class; the agencies by which most pathogenic bacteria incite disease is through their endotoxins, poisons closely bound up with and contained within the bacterial cells, and against which antitoxins are not elaborated by the infected animal body. It was the research of Pfeiffer on cholera in 1891 which lead to a differentiation of exotoxins and endotoxins.[80]

In spite of the fact that no antitoxic defence is manifested by the body against most bacterial invaders, it soon was discovered that the body does exhibit a humoral (body-fluid) defence, not alone against the bacterial poisons but against the bacteria themselves. John Hunter, Traube and Lister had all observed the anti-putrefactive action of shed blood and body fluids, but apparently Grohman, in 1884, was the first experimentally to demonstrate that fresh blood plasma has an inhibitory effect upon bacterial growth. In 1888, Flugge and Nuttall[81] actually demonstrated under the microscope the destruction of such bacteria as B. anthracis by the defibrinated blood, as well as by the pericardial and pleuritic fluids, of rabbits, mice, sheep, dogs and pigeons. In 1889, Buchner[82] still further narrowed the search by showing that this antibacterial property of the blood resides in the blood serum; to the bactericidal substances in the blood he gave the name alexins (to ward off, or protect). In 1894, Pfeiffer[83] announced his discovery that if cholera vibrios are injected into the peritoneal cavity of an immunized guinea pig, the bacteria quickly lose their motility, swell, become granular and finally dissolve (Pfeiffer's reaction). Not alone did he demonstrate that cholera vibrios do not undergo such dissolution when injected into the peritoneal cavity of a normal, non-immune animal, but he also showed that if a little blood serum from a cholera immune guinea pig is injected along with cholera vibrios into the peritoneal cavity of a normal animal, dissolution of the bacteria does take place.

Following this discovery by Pfeiffer of the lysogenic or bacteriolytic property of an immune serum, it was found that this reaction also occurred in a test tube with fresh, immune serum, but that on standing, or on heating the serum to 56°C. for half an hour, the bacteriolytic power of the serum was destroyed. However, if to this heated immune serum was added fresh, normal serum from the same animal or from another species of animal, the vibrio-dissolving power of the serum was restored. In other words, there are two components in a cholera-immune serum, both of which are necessary before the bacteriolysis characteristic of Pfeiffer's reaction can occur. Further analysis of this phenomenon at the hands of Bordet.[84] Ehrlich and Morgenroth[85] and Metchnikoff brought out the close resemblance between a bacteriolytic immune serum and a hemolytic immune serum, the latter pre-

pared by immunizing an animal against alien red blood corpuscles, just as the former is prepared by immunizing an animal against a bacterium, such as the cholera vibrio. Bordet found, by a series of classical experiments, that the thermolabile (heat-sensitive) constituent of both hemolytic and bacteriolytic immune serum, which he called the "substance bactericide" was the same, and he identified it with Buchner's "alexin" and Ehrlich and Morgenroth's "complement." The thermostable (heat-resistant) component of bacteriolytic and hemolytic immune serum was called by Bordet "substance sensibilisatrice," a component of serum synonymous with Ehrlich's "amboceptor" or "immune body." The subsequent work of Bordet and Gengou[86] on the reaction of "complement fixation" found practical diagnostic application later in such tests as the Wassermann reaction, a serological method for the diagnosis of syphilis devised in 1906 by August Wassermann (1866–1925).

Almost coincident with Pfeiffer's discovery that certain bacterial invasions of the animal body incite the body to the production of specific bacteriolytic substances which can be demonstrated in the circulating blood, Gruber and Durham[87] discovered another product of bacterial invasion of the animal body, to which the name agglutinin has been given. They noted that if the blood serum of an animal immunized against B. typhosus be added to a homogeneous suspension of typhoid bacilli, the previously cloudy fluid clears and the bacilli are clumped at the bottom in a coherent, viscid mass, i.e. the bacteria are agglutinated; cholera vibrios mixed with typhoid antiserum are unaffected. It was Widal[88] who first gave this discovery of agglutinins a practical diagnostic application, by showing that the blood serum of a patient suffering from typhoid fever, when mixed with typhoid bacilli, will specifically agglutinate these bacilli, thereby affording a test by means of which it can be determined whether a given patient is suffering from a typhoid infection or not. This test is generally known as the "Widal reaction," or better the "Gruber-Widal reaction." Since Gruber's and Widal's pioneer researches, the agglutination test has proved of immense value in the clinical study not only of typhoid fever, but of other infectious diseases such as the paratyphoid fevers, typhus fever, Malta fever and dysentery. In 1897, Kraus[89] discovered precipitins in serum, substances closely allied in nature to agglutinins. He found that if he mixed a clear filtrate of a typhoid bacillus culture with typhoid antiserum, a specific cloudiness or precipitate appeared in the tube. The same phenomenon occurred if a plague bacillus filtrate was mixed with plague antiserum or if a cholera vibrio filtrate was added to cholera antiserum. In each instance the reaction was specific, i.e. no clouding occurred if, for example, a typhoid bacillus filtrate was mixed with plague antiserum, or with cholera antiserum. In the hands of Ascoli, Bordet, Nuttall and others, it was found that the precipitin test not only could be practically applied in the diagnosis of certain diseases, such as glanders and anthrax, but that its use could be extended still wider for the identification of animal and plant proteins. And it was Uhlenhuth who showed that the test had a wide medicolegal use, especially in the identification of human blood.

All of these detailed discoveries turned the scientific spotlight upon the fluid elements of the body. They showed that, in many bacterial diseases, combative substances such as antitoxins and bacteriolysins could be demonstrated in the blood, whose action was directed either against poisonous products of the invading bacteria, or against the bacteria themselves. Out of these discoveries arose the Humoral Theory of Immunity, a modified return to the ancient teachings of Hippocrates, in which the proper concentration of defensive substances in the humors of the body was substituted for the proper concentration of bile and mucus, as constituting the mechanism by means of

which contagious diseases are prevented or cured. But already a rival Cellular Theory of Immunity was finding vociferous scientific adherents. The attempt to prove that the major defence of the body against bacterial invasion resides in the cellular elements of the blood stream and of the tissues really dates from the early studies of Metchnikoff[90] (1845–1916) in which he showed the immense importance of the leucocytes (white cells) of the blood in freeing the body of pathogenic bacteria. This result, he demonstrated, is brought about by the fact that leucocytes move by throwing out protoplasmic processes which are able to engulf, and then destroy by a process of digestion, foreign bodies such as bacteria. To such cells he gave the name "phagocytes" (to eat cells), and the process by which bacteria, and other foreign substances, are engulfed he called "phagocytosis." At the hands of Metchnikoff and his students a further differentiation of phagocytes into "wandering cells" and "fixed tissue cells" was made; the rôle of phagocytosis in such infections as anthrax, tuberculosis, cholera, gonorrhea and staphylococcus and streptococcus infections was elaborated upon. Metchnikoff's fundamental studies upon phagocytosis were soon amplified by test-tube experiments performed in 1895 by Denys and Leclef.[91] They showed that if leucocytes and streptococcus-immune serum and streptococci are mixed, the increased phagocytosis, as evidenced by the greater number of streptococci engulfed by the leucocytes, is due to substances in the immune serum which act upon the bacteria and make them more readily ingested. Still later, in 1903, Wright and Douglas[92] proposed the term "opsonin" (I prepare food for) for the thermolabile substances in fresh, normal serum and in immune serum, which act upon bacteria and make them more susceptible to phagocytosis. Now that a certain degree of convergence between the opposing "humoral" and cellular" theories had been demonstrated, Ehrlich[93] (1854–1915) attempted to unite the diverse phenomena of the two systems into one great theory; out of this attempt he developed his famous "Side Chain" Theory of Immunity.

While the battle over the mechanism of immunity was being waged, fundamental discoveries regarding certain protozoon diseases were being made. In 1893, Theobald Smith (1859–), the great American comparative pathologist and bacteriologist, immortalized himself by giving to the world the first scientific proof that an arthropod (a tick) may as serve a carrier of a protozoon disease. In that year, Smith and Kilborne[94] published the results of researches conducted from 1889–1892 upon an infectious disease of cattle, variously known as Texas fever, redwater or piroplasmosis, in which they showed that the disease is due to a protozoon parasite, Piroplasma bigeminum, which is transmitted by ticks of the genus Boophilus. This brilliant discovery paved the way for that classical series of investigations upon insect carriers of disease, which culminated in the triumphant proof that malaria and yellow fever are mosquito-borne, which in turn pointed the way to the control of these ancient scourges of the human race. Smith and Kilborne, patiently at work on the wind-bitten plains of Texas, were doing more than studying ticks; for one thing they were helping to make the building of the Panama Canal possible!

As early as 1894, the year in which Yersin[95] and Kitasato[96] independently isolated B. pestis, the bacterial incitant of bubonic plague, Patrick Manson formulated his fertile theory that malaria is a mosquito-borne disease. He laid special stress upon the phenomenon of "ex-flagellation" exhibited by the malaria parasite in drawn human blood, and showed Ronald Ross (b. 1857) that this phenomenon pointed directly to a further development of the parasite in a blood-sucking insect.[97] He convinced Ross that he should work out the problem in India after giving him, as Ross himself wrote in 1900, "a chain of reasoning from which it was impossible to escape." This led to

Ross observing ex-flagellation take place in the body of the mosquito (1895); in 1897–98 he saw crescent-derived, pigment-bearing parasites in the gut-wall of Anopheles mosquitos. Thereafter, he followed out the complete cycle of development of the malaria parasite (Plasmodium), thus scientifically establishing the fact that certain mosquitoes are the living carriers by means of which malaria is spread from man to man.

In 1900, The United States Army Commission on Yellow Fever was formed, consisting of Walter Reed, James Carroll, Aristides Agramonte, and Jesse W. Lazear; of this Commission Walter Reed (1851–1902) was president and, according to General Leonard Wood, "the originating, directing and controlling mind." The Commission, which began its investigations in Cuba in August 1900, first began a series of experiments in which mosquitoes, chiefly of the species Stegomyia, were allowed to first feed upon the blood of yellow fever patients, and then, later, the same insects were made to feed upon normal, non-immune individuals. The first nine human experiments were negative; but the tenth, in which Carroll was the voluntary subject, was successful. Four days after being bitten by an infected yellow fever mosquito, Carroll developed a severe attack of yellow fever, from the effects of which he died a few years later. On September 13, Lazear, at work in the yellow fever wards, observed a Stegomyia alight on his hand. Deliberately, Lazear watched the mosquito drink its fill of his blood. Five days later he became violently ill with yellow fever and, after a short illness, died. The results obtained by the Commission[98] can briefly be summarized as follows: Yellow fever is naturally acquired by the bite of one species of mosquito only, the Stegomyia fasciata, and then only if the mosquito has sucked the blood of a yellow fever patient during the first four or five days of the disease. It requires an incubation period of at least twelve days, after the mosquito has had its meal of infected blood, before the mosquito becomes infective, and can transmit the disease to another susceptible individual, by biting. Of the scientific findings of this Commission Professor W. H. Welch wrote in a letter to the Secretary of War of the United States: "they constitute one of the most valuable contributions to medicine and public hygiene which have ever been made in this country, with the exception of anesthesia." Speedy confirmation of the Commission's conclusions followed and William Crawford Gorgas (1854–1920) immortalized himself by putting into practical application in Panama the principles of mosquito control, which have led to the virtual conquering of malaria and yellow fever.

In 1905, Schaudinn (1871–1906),[99] among whose earlier fundamental contributions was the working out of the life cycle of certain coccidia, and the tracing of the different stages of the malaria parasite in human red blood corpuscles, capped his brief and brilliant career by his discovery of Treponema pallidum, the cause of syphilis. Not until 1911 was the Treponema pallidum successfully cultivated outside of the body; this was first accomplished by Noguchi,[100] who so recently has fallen a martyr to yellow fever in Africa.

In conclusion, it should be noted that a considerable number of highly infectious diseases of both man and animals have been found to be caused by filterable viruses. As early as 1898, Loffler and Frosch,[101] while studying a highly contagious disease of cattle, foot-and-mouth disease, which also is transmissible to man, made the astonishing discovery that the virus of this disease is able to pass through the pores of the finest porcelain filter. They took lymph from an infected animal and filtered it, and they found this filtered lymph to be germ-free, so far as recognizable bacteria were concerned. Yet as small an amount as 0.02 c.c. of such filtered lymph was capable of inciting, on injection, foot-and-mouth disease in a healthy cow. From this animal, they transferred the infection to six

successive animals, and it was estimated that the sixth calf, in the series, received less than one two-billionth of the original lymph. Because of the experimentally determined fact that one fifty-thousandth part of the original lymph was not infectious, Loffler and Frosch drew the justifiable conclusion that the filter-passing virus of foot-and-mouth disease must be an invisible, but living, microorganism capable of multiplication. Since 1898, almost fifty diseases of man, animals, and plants have been demonstrated to be caused by filterable viruses; among the more common virus diseases of man are smallpox, rabies or hydrophobia, and epidemic infantile paralysis. During the course of an unsuccessful attempt to cultivate filterable viruses, Twort, in 1915, discovered the bacteriophage phenomenon, or transmissible lysis of bacteria, since studied intensively by d'Herelle,[102] and usually referred to as the Twort-d'Herelle phenomenon.

A recent discovery of outstanding note was the experimental demonstration by Dr. and Mrs. Dick[103] that hemolytic streptococci are the causative bacterial factor in scarlet fever, a discovery which already has opened the way for the prevention and control of this dread scourge of childhood.

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BOOK REVIEWS

Minor Surgery. By Frederick Christopher, M.D., F.A.C.S. Phila., W. B. Saunders Co., 1929.

An excellent book of 694 pages is offered the physician on the subject of Minor Surgery. The only criticism, if one wishes to lean over backwards, is that in some instances the author considers surgical problems that are in reality major. However, to anyone who does not pretend to specialize in surgery but is, by circumstances, forced to handle the many minor surgical conditions, this work is complete in every detail, and a worth while and necessary factor in his work.

At that many surgeons who confine their practices to that specialty might read the pages with profit. This, because many men can perform the most intricate abdominal or thoracic operations and, at the same time, make a horrible mess of the removal of a fish-hook from a finger.

We trust the book will have a large sale as no apologies need be made for offering it to the profession.

The History of Nursing. By James J. Walsh, M.D., Ph.D. N. Y. P. J. Kennedy & Sons, 1929.

If you do not believe that a history of nursing could make interesting reading you will be pleasantly disillusioned if you take up this book. Doctor Walsh writes with sympathy of the age-old problem confronting all nations, all communities: the care of the ailing. The manner in which the problem was, and is, met makes a story that is interesting, delightful and instructive not only to the nurse but also to the general public.

Doctor Walsh tells some startling facts of the degradation of nursing and the terrible conditions existing in our hospitals even during the nineteenth century. Two important features were responsible for raising the standard of nursing to its present status, the work of the Catholic Nursing Orders and the vision and foresight of Florence Nightingale.

History becomes vital when Doctor Walsh lends his facile pen to the task. We sincerely hope that this excellent book will not go unappreciated by those who follow the profession of nursing, or those who merely read for diversion.

Textbook of Surgical Nursing. By Ralph Colp, M.D., and Manelva Wylie Keller, R.N. Ed. 2. N. Y., Macmillan Co., 1929.

This worthwhile book deservedly is brought out, entirely rewritten, in a second edition. To our mind the fact that a work goes through more than one edition is simple proof the book is a necessary factor in the professional lives of nurses. The book is used in many schools of nursing as a standard textbook. It covers the subject thoroughly, is written interestingly and is well illustrated. As a physician, only casually interested in the many didactic angles of the nursing profession, I found myself absorbed in the pages of this valuable volume.

Ker's Infectious Diseases. A Practical Textbook. Revised by Claude Rundle, O.B.E., M.D. (Lond.), M.R.C.S. (Eng.). Ed. 3. N. Y., Oxford Univ. Press, 1929.

Ker's Infectious Diseases needs no introduction to the average physician interested in internal medicine. This work, a practical textbook, now in its third edition, has been revised by Claude Rundle, lecturer on infectious diseases to the University of Liverpool. Doctor Rundle has done a good bit of work. If one does not know it and does not own it and if one has any interest in this universal subject, we sincerely recommend this book.

Some Principles of Minor Surgery. By Zachary Cope, M.D. N. Y., Oxford Univ. Press, 1929.

We quote from the author's Preface: "In this little book I have attempted to lay stress upon certain elementary general principles which are sometimes in danger of neglect. It is meant chiefly for post-graduates who will be able to appreciate where orthodox views are departed from." The author lives up to these promises. The book contains chapters on The Use and Abuse of Antiseptics, The Principles of Treatment of Acute Inflammation, Common Mistakes in the Diagnosis and Treatment of Acute Abscess, Diagnosis and Treatment of Infections of the Hand, Common Sprains and Their Treatment, Ambulatory Fractures and Their Treatment, The Treatment of Retention of Urine Due to Enlarged Prostate, Some Minor Operations, and an Index. It is a sound work.

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